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COMPLEX MOTOR SKILL PERFORMANCE UNDER
CONDITIONS OF EXTERNALLY
INDUCED STRESS

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF ARTS

FACULTY OF PHYSICAL EDUCATION

by

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EDMONTON, Alberta

June, 1965.

APPROVAL SHEET
UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies, a thesis entitled "Complex Motor Skill Performance Under Conditions of Externally Induced Stress" submitted by Albert Vital Carron in partial fulfillment of the requirements for the degree of Master of Arts.

ABSTRACT

This study was designed to investigate the effects of a shock stressor upon the performance of high- and low-anxious subjects during the learning of a complex motor task. A secondary aspect was the assessment of the effects of this shock stressor when introduced 'early' or 'late' in the learning process.

Sixty high-anxious and sixty low-anxious students from the University of Alberta male freshman population were selected as subjects and assigned to one of three equal groups: Control; Stress Early; and Stress Late.

The learning task consisted of seventy 20 second balancing trials on the stabilometer. All trials were under control conditions except for trials four to six for the Stress Early Groups and trials sixty-five to sixty-seven for the Stress Late Groups.

Within the limitations of this study, the following conclusions were made. The high- and low-anxious groups did not differ significantly in amount learned throughout the task. The shock stressor had no effect on the amount learned on the stabilometer. The high- and low-anxious groups differed significantly in their final levels of performance. When the shock stressor was introduced "early" it had a differential effect on the two experimental groups, with the high-anxious group showing a significant impairment effect while the low-anxious group were unaffected. The shock stressor introduced "late" in the learning process produced an almost identical

decremental effect on both the high- and low-anxious groups.

ACKNOWLEDGEMENT

"There are two ways of exerting one's strength: one is pushing down, the other is pulling up" (Booker T. Washington). Upon the completion of this work, I cannot help but reminisce to various periods during the development of this project when the encouragement, guidance, constructive criticism and/or advice of numerous people helped 'boost' this work toward completion. Without the combined "strengths" of these people "pulling" with and for me, this thesis would not have been possible.

To Dr. W.R. Morford, my committee chairman, I owe an irredeemable debt, in terms of both time and energy, and a heartfelt thanks for countless contributions during the shaping of this thesis.

To Dr. M.L. Howell, who provided encouragement and advice throughout this work, my sincere gratitude and appreciation is extended.

To Dr. W.N. Runquist, whose assistance and advice contributed to the satisfactory completion of this thesis, I am grateful.

To my wife Lynne, a special thanks is extended for her encouragement and understanding during the "black hours" of my efforts.

To my classmates, who aided the development of this thesis with their questions, advice and constructive criticism, I wish to express my thanks.

Finally, I wish to gratefully acknowledge the cooperation of the subjects who volunteered their time so willingly to participate in this study.

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CHAPTER I

STATEMENT OF THE PROBLEM

Introduction. Motor learning plays an important role in virtually all human activity. While the principles governing the acquisition and retention of motor skills have special application for physical educators, the implications for the highway, industry, the home and the school are equally important. Extensive research has centered around the problem of how skills are acquired and the conditions and methods which facilitate the learning of any task. The part versus the whole method, massed versus distributed practice, and the use of punishment versus praise as a motivator are only the more general problems bearing on this area.

As an extension of the latter problem (punishment versus praise), the role of stress in motor learning has recently been given a great deal of attention. According to Ryan (4:103),

The effects of stress on performance are far from clear. Stress has been shown to either improve or impair performance depending upon varying experimental conditions. Two factors that appear important in determining the effects of stress are the relative difficulty of the skill to be performed, and the degree of proficiency in the skill when stress is introduced.

This possibly explains in part the wide divergence of results which have accrued from the various studies dealing with the problems of stress and/or motivation and their effect on learning. Generally, stress (or motivation, tension, incentive or increased drive level) has facilitated learning

and performance in a great many cases, but has impeded or caused no change in performance in an equal number of studies. No apparent relationship appears to exist between the type of stressor used and the direction and change in performance.

An explanation to account for some of these discrepancies may be offered in terms of the drive theory proposed by Hull (2) and later modified by Spence (5:131)¹. According to this theory, habit strength (sHr) and drive (D) jointly determine response strength (sEr). If this is so, then whether an increase in drive (i.e. stress) will produce a facilitation or decrement in performance will depend upon the relative strengths of any competing habits. Thus, in a complex task (one involving strong competing responses), if the habit strengths of the competing incorrect responses are greater in relation to the correct ones, impairment of performance should be expected with an increase in drive (D). However, if the correct responses are dominant (their strength is greater in relation to the incorrect ones), facilitation should be expected.

Logically, then, stress may be expected to improve the

¹"The critical difference between the two theorists is that Spence has assumed that the motivational variables (drive and incentive) interact additively, whereas Hull assumed that this interaction was multiplicative. In general a multiplicative interaction implies that if any variable is zero, then the product is also zero. An additive interaction on the other hand implies that neither drive nor incentive is a necessary condition of performance, although at least one must be present". (3:325)

performance of an easy task where the strength of the correct response to be learned is somewhat stronger than that of the incorrect responses. On the other hand, in a complex task, stress may be expected to improve performance only after considerable learning has occurred, enabling the habit strength of the correct reinforced response to overtake the incorrect non-reinforced response. Thus, with an increase in drive, the degree of impairment or facilitation is positively related to the relative strength of the concomitant habit at the time of the increase.

Complicating the above theoretical formulation is the known fact that individuals vary considerably in the level of their emotional responsiveness to a stressful or novel situation. The interaction of a chronic drive level with an experimentally induced drive level alters the absolute level of drive (D) in an experimental situation.

In recent years, with the introduction of the Manifest Anxiety Scale (MAS) by Taylor (6:285) (7:303), many investigators have defined drive (D) in terms of scores on this personality inventory. Taylor (7:306) suggests that the use of the MAS is based on one of three possible assumptions:

- 1) Scores on the scale are related in some way to emotional responsiveness, which in turn contributes to drive level.
- 2) Test scores reveal differences in the chronic emotional state of the individual who scores high on the scale will

bring a higher level of arousal or emotionality to the experimental situation.

- 3) Test scores reveal different "potential levels of arousal", high scoring subjects being those who tend to react more emotionally, and adapt less readily to novel or threatening situations.

The Problem. The purpose of this study is to investigate the effect of externally induced stress on the performance of high- and low-anxious subjects during the learning of a complex motor task.

Sub-Problems. The following sub-problems are an extension of the main problem:

- 1) to determine the effect of stress on performance of high-anxious subjects when stress is introduced early in the learning process as contrasted to when stress is introduced late in the learning process.
- 2) to determine the effect of stress on performance of low-anxious subjects when stress is introduced early in the learning process as contrasted to when stress is introduced late in the learning process.
- 3) to compare the differences between high-and low-anxious subjects in their reaction to stress introduced early in the learning process.
- 4) to compare the differences between high- and low-anxious subjects in their reaction to stress

introduced late in the learning process.

- Assumptions. Throughout this study it will be assumed that:
- 1) the Taylor Manifest Anxiety Scale (MAS) is a measure of emotionality differentiating subjects on the basis of chronic, innate motivation and emotion in test-like or experimental situations.
 - 2) the experimental stressor, electric shock, will provide an increase in anxiety (emotionality) within the experimental situation for all subjects.
 - 3) any changes in the learning curves of the experimental groups different from those of the control groups may be attributed to either the experimental stressors or to an interaction effect of experimental stressor X anxiety condition.
 - 4) learning on the stabilometer is manifested by a decrease in the total number of movement units on successive trials.

Definitions. For the purposes of this study the following definitions apply:

- 1) Stress - A state of heightened emotionality and drive level produced by the threat of, and/or administration of, electric shock.
- 2) Stabilometer. A horizontally pivoted platform 107 cm. long and 61 cm. wide, fastened to a cross-wide pivot rod of heavy steel that turns on ball bearings. The platform is 25 cm. above the center of rotation (2:3). The score per trial is determined by

counting electrically the total number of "movement units" (degrees of movement) per twenty second trial.

- 3) Anxiety - As measured by the MAS, anxiety is a "state of emotionality" (7:303). Subjects scoring high on this scale have a higher level of innate emotionality in an experimental situation than do low scoring subjects.
- 4) High Anxious Subjects - Subjects who obtain a score of twenty-one or above on the Taylor MAS.
- 5) Low-Anxious Subjects - Subjects who obtain a score of seven or below on the Taylor MAS.
- 6) Learning - This is operationally defined as improvement in performance. It is inferred that learning has occurred when there is improvement in performance, presumably caused by practice; it necessarily excludes improvement caused by physical training, muscle strengthening, changes in motivation and the like.
- 7) Motor Learning - This is learning in which improvement is in the motor performance itself, rather than in the learning of the correct order of a sequence, the association between a stimulus and a certain response, a cognitive relationship or a spatial relationship (as in a maze). Motor learning may be assessed by improved precision, improved muscular coordination between several muscular components of a task,

greater speed of movement, etc.

- 8) Performance - This is the score received on a trial during the testing period. The score is measured in objective units, e.g., precision of movement.

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CHAPTER II

REVIEW OF THE LITERATURE

Classical Conditioning. The earliest work with the Manifest Anxiety Scale was in the area of classical conditioning. Taylor (65:81) and Spence and Taylor (62:183) were the earliest researchers. They demonstrated that high anxious (HA) subjects developed conditioned eyeblinks at a faster rate and to a higher asymptote than low-anxious (LA) subjects. These results were later duplicated by Baron and Conner (4:310), Farber and Spence (14:120), Spence and Beecroft (58:399) and Spence and Farber (59:116).

Spence and Weyant (64:146) omitted the ready signal used by previous experimenters and demonstrated similar results to the Spence and Taylor (62:183) experiment. They concluded that the warning signal had "... little or no effect on the absolute level or difference in levels of conditioning performance between high and low anxious subjects". (64:149)

However, King et al (26:532) using methodology identical with the previously mentioned studies, failed to find similar results. In fact, not only did they not find a significant difference in favour of the HA subjects, but two of the differences, though not significant, were in favour of the LA subjects.

Spence (57:129), in an attempt to ascertain the reasons for the diverging results, compared the various studies involved with conditioning and the MAS. After comparison of the data,

the number of subjects, and the experimental conditions, he concluded that the major factors which appeared to be responsible for a failure of the HA-LA differences to occur in some studies were: a) a small number of subjects, b) the presence of voluntary responders within the sample, c) a lack of experimental naïvete on the part of the subject thus resulting in "... less fearful and, all too often, quite bored and blase" attitudes on the part of the subjects. (57:135)

Research later shifted to the area of learning (motor and verbal) and a large number of studies using the Manifest Anxiety Scale (MAS) specifically investigated the Hullian and/or Spence hypothesis. Related to the learning of simple tasks, it is postulated that HA subjects will perform better than IA subjects. Since their higher drive state combines with the simple correct habit thus improving performance. However, in a complex task, it is theorized that HA subjects will not do as well initially as the LA subjects because of the tendency for their high drive to combine with any of a number of competing incorrect response tendencies. However, later in learning, after the number of competing incorrect habits has decreased, the higher drive state of the HA subjects coupled with the correct habit should be expected to result in a facilitation of performance. Studies dealing with the use of the MAS as a measure of drive (D) are reviewed here within the areas of verbal learning and performance and psychomotor learning and performance. In

addition, studies not concerned with the MAS but investigating drive theory will also be reviewed.

Effects of Stress and the MAS Upon Verbal Learning and Performance. Spence, et al (61:296)(63:306) dealt with the problem of competing responses in the habit strength continuum. Using subjects who scored at the extremes of the MAS, they examined the learning of paired-associates in situations where responses were either competition- al, or where there were different degrees of competition between the right and the wrong responses.

In the initial experiment (61:296), it was hypothesized that ". . . in the case of the list (of paired-associates) having a minimum of generalization among S-R pairs, and therefore, little competition among responses, high-anxiety subjects would perform better than low-anxiety subjects," while ". . . in the case of a list in which competing incorrect responses could be expected to be stronger than the correct responses, high-anxiety subjects would perform more poorly than low-anxiety subjects" (61:297). Both hypotheses were verified in the experiment.

Spence, et al (63:306) then considered this same problem using paired-associate learning problems involving different degrees of competition between right and wrong responses. A significant interaction was found between anxiety level and the type of paired-associate item, with high-anxiety subjects being superior when learning involved a minimum of competition between S-R pairs, and the low-anxiety subjects being some-

what better (not statistically significant) when the learning involved strong competing response tendencies.

Taylor and Spence (69:61) noted a decrease in errors and more rapid learning for low-anxious subjects in a verbal-maze situation. The high-anxious subjects exhibited a decrement in performance in the same situation. This was interpreted by the authors as being the result of the opportunity for interference allowed in the multiple response situation and therefore it was postulated that the higher drive in the anxious subjects resulted in a decrement on this task because anxiety increased the strength of all responses, including competing ones.

Further support of these findings is provided by Montague (40:91). High - and low-anxious subjects were presented with three different lists of serial nonsense syllables which differed as to intra-list association value and intra-list formal similarity. A significant interaction was found between anxiety and list, with the anxious group being significantly superior in performance to the non-anxious group on the list for which similarity was low and association value high, and the position being reversed for groups given a list of high similarity and low association value. Taylor and Chapman (68:671) and Lucas (34:59) confirmed these results.

Lee (33:213) also investigated the Hullian drive theory in an experiment similar to that of Montague (40:91). Shock and manifest anxiety were taken as measures of drive in a verbal learning situation in which the transfer list con-

tained three types of S-R pairs: a) new S-R pairs, b) changed S-R pairs, and c) unchanged S-R pairs. The results lend support to the hypothesis that scores on the MAS may be interpreted in the Hullian theory. The results with the second list indicated that an increase in D (in terms of anxiety and/or shock) significantly facilitated performance when the dominant habit was correct. When the dominant habit was incorrect, an increase in D significantly impaired performance. According to Lee (33:216) "The results also give evidence that anxiety as measured by the MAS should be considered chronic, i.e. present in experimental situations regardless of the presence of shock".

Korchin and Levine (28:234) compared thirty-six high-anxious and low-anxious subjects in the learning of familiar tasks ("congruent with greatly overlearned habits") and unfamiliar tasks ("incongruent with pre-existing habits"). These authors were in agreement with the above investigators in that they found high-anxious subjects to be inferior to the low-anxious subjects when the habit of the incorrect response was stronger but were unable to verify the statement that high-anxious subjects perform significantly better than low-anxious subjects in tasks where the habit strength of the correct response was stronger than the habit strength of the incorrect response.

It was observed that for the more novel and difficult items, the high-anxious subjects learned significantly less overall and showed a somewhat slower rate of learning from

trial to trial than did the low-anxious subjects. The authors state that:

The lower the initial anxiety, the less is the effect of differences in the experimental conditions; for more anxious subjects, even small changes lead to sizeable changes in performance (28:239).

Sinha and Singh (54:469) administered the MAS to a number of students and selected subjects from the two extremes on the scale and gave them a series of problem-solving tasks. High-anxious individuals required significantly more time to solve all the problems. The authors state that the increased drive multiplied "indiscriminately" the strength of the competing responses and that performance was not as sound due to (54:469) ". . . anxiety produced interference".

Taylor (67:55), discussing the performance of high-and low-anxious subjects in experimental situations suggests:

. . . another characteristic on which high- and low-anxious subjects may differ is their susceptibility to irrelevant extra task responses under conditions of psychological stress. It might be predicted that under neutral conditions high-anxious (increased drive) subjects would exhibit a performance superior to that of low-anxious (decreased drive) subjects on a paired-associates learning task with minimal intra-task interference, but under conditions of psychological stress, high-anxious subjects, due to greater arousal of interfering extra-task responses, would no longer exhibit the superiority found under neutral conditions (67:59).

Eighty high- and low-anxious subjects were equally divided into two groups. On the initial test all subjects were told that the test was a measure of intelligence, while on the second test, one-half of the group were told that they had

failed test one and would repeat another test, with the other half of the group being told that it was just another test. Taylor found, as expected, that the high-anxious subjects exhibited the superiority in performance-predicted by the drive theory in test one under neutral conditions. On the second test the group operating under failure stress showed a significant decrement in subsequent performance when compared with the neutral controls. However, no evidence was found to support the contention that high-anxious subjects were more prone to exhibit these extra-task responses.

Using the Neuroticism Scale (similar to Taylor's MAS) of the MMPI, Deese, et al (12:55) studied anxious and non-anxious subjects in a serial learning experiment under two experimental conditions: avoidance learning, where the list was read through once and then on the second and subsequent trials, an electric shock was applied to the leg for every incorrect response or failure to respond, and non-avoidance learning, where subjects were shocked randomly, irrespective of the correctness of their response. A control group was also included. Results indicated that under the two conditions of shock, the low-anxious subjects fell below their control group in performance, the "high groups" gave consistently more correct responses, and in the avoidance learning situation they showed a facilitation of performance when under stress. When all conditions were combined, the high-anxious subjects were significantly superior to the low-anxious subjects. However, Deese, et al (12:59) point out,

"This difference cannot be accounted for in terms of anxiety as a 'drive' (that is, in terms of improved performance of the anxious group), but rather must be interpreted in terms of a decrement in performance on the part of the non-anxious group".

In a follow up study, Lazarus, et al (30:111) studied the same problem. However, this time, the serial learning task involved a more difficult list (twelve consonant syllables composed of only five consonants). This difference in lists produced results which were markedly different from the previous experiment. No significant difference between the performances of the two anxiety groups was found. The obtained mean differences between the groups were actually in the opposite direction to that found in the earlier study. However, Taylor (66:311) in discussing these results, states:

While these results appear to be contradictory both to drive theory (which would expect inferiority of anxious subjects) and to the results of the first study with respect to the influence of shock, inspection of their data indicates that all groups averaged only about one correct response per trial. Since so little learning took place, it is not surprising to have no differences in performances among groups. For this reason it is felt that the study does not provide very meaningful evidence on the effects of either anxiety level or shock on task performance.

Sarason (52:383) approached this same problem from a modified point of view. He divided high-and low-anxious subjects into two equal groups, gave them an initial test and then informed them that they had failed. One group was

failed on a preliminary list of nonsense syllables which was quite similar to a list on which they were to be subsequently tested, while the other group was failed on a digit cancellation test, completely dissimilar to the forthcoming test. It was noted that there was an overall superiority of low-anxious to high-anxious groups after failure with the two kinds of failure situations being equally effective as a stressor for the latter group. The high- and low-anxious control groups did not differ significantly.

Waite, et al (74:267) in a subsequent study, used a similar approach. Using twenty-four pairs of high- and low-anxious children in grades two to five, the authors investigated the effects of two different reports of results of an initial test upon performance in a second test. The children were given a modified paired-associates learning task and then informed that they scored at a level two grades above their year (success), or two grades below their year (failure). The control group was simply told that they were going to take a second test. There was no significant difference between the anxiety groups on the first test but on the second test, the low-anxious experimental groups performed better than the high-anxious groups.

In an experiment by Sarason and Palola (53:185) in which high-anxious and low-anxious university students were given either a difficult or easy digit symbol test under "neutral" and motivating" instructions, it was observed that the

"motivated" group performed at a significantly higher level than did the "neutral" group. In agreement with the Hullian drive theory, low-anxious subjects exhibited a superiority on the difficult task, while the reverse was true for the easy digit symbol test, with high-anxious individuals showing a superiority. The authors conclude, ". . . in general, high difficulty of task and highly motivating instructions combined to affect detrimentally the performance of high-anxious subjects" (53:110).

In another experiment, Sarason (50:253) studied the effects of two instructional variables, termed high and low-motivating (one group was told that the test was related to intelligence, while the other group was told that the test was designed to demonstrate the associative value of nonsense syllables); two performance reports, failure or non-failure; and anxiety on performance in a serial learning situation. Although the anxiety variable alone did not result in differences in performance, the results revealed that high motivating instructions were detrimental for high-anxiety subjects and facilitating for low-anxiety and middle-anxiety groups. The low motivating instructions yielded results which varied according to anxiety score. High-anxiety low-motivated subjects performed at a higher level than high-anxiety high-motivated, while the reverse was the case for low-anxiety and middle-anxious subjects, with high motivation instructions resulting in a higher level of performance than low motivating instructions.

Sarason, (50:253) in analyzing his results, suggests:

Two possible theoretical interpretations suggest themselves on the basis of the findings concerning the interaction between anxiety and motivational instructions. One, a drive interpretation, stems from Taylor and Spence's view that score on the Taylor scale reflects the general drive level of the individual and that this drive had the properties of Hull's D. In the present experiment, high motivating instructions were facilitative for middle- and low-anxious groups, and detrimental for high-anxious groups. It might be hypothesized that high motivating instructions increased the general drive level of Ss, whereas low motivating instructions left it unchanged. If this were the case, it is possible that up to a certain point increases in motivational level are facilitative for performance and beyond this point increases in motivational level are detrimental.

Another hypothesis places greater emphasis on associative factors. Such a hypothesis would consider high-anxious Ss as having learned certain detrimental responses to situations similar to that with which Ss were confronted in the present experiment. For example, HA Ss might place a high premium on excellence of performance in situations in which their behaviour is being evaluated (e.g., taking an intelligence test) and might verbalize to themselves during their performance about the importance of a high level of attainment. Quite conceivably such verbalizations could have an interfering and detrimental effect on their performance. For LA Ss on the other hand, high motivating instructions may act as a stimulus for increased effort in the performance of the task with which they are confronted.

Davidson, et al (11:13), in a similar study, also indicated that manifest anxiety (as measured by the MAS alone) does not produce differential effects in performance. Fifty-four male undergraduates were tested on a continuous-high-speed-colour-naming task ". . . which was considered representative of a wide variety of performances involving

continuous visual discrimination" (11:13). Both task-induced stress (speed of presentation varied) and failure stress (verbal instructions and shock as an indication of failure) were introduced, resulting in significant decrements in performance. Commenting on the manifest anxiety variable, the authors (11:16) point out,

It appears from the results of this study that anxiety classification as such does not produce differential effects on the continuous high-speed, colour-naming performance. However, the several significant interactions obtained between anxiety and the experimental conditions indicate a possible "priming" function of anxiety for other stress effects. Anxiety served to increase the subject's susceptibility to the effects of stressful conditions.

Wallach and Gahm (75:387) examined the interactive effects of manifest anxiety and introversion-extroversion influencing possible approaches to a probability learning situation. Under the assumptions that a high level of anxiety disrupts attempts at rational, deliberative solving of a complex problem, and that extroverts are impulsive and less contemplative than introverts, the authors theorized that (75:387):

The presence of older subjects of high-anxiety and extroversion might be expected to favor the occurrence of the thoughtless "50-50" approach. On the other hand, the presence of older subjects of low-anxiety and of introversion might be expected to favor the occurrence of the "thoughtful, deliberative problem approach".

In the probability learning situation which required subjects to predict which of two alternatives would appear on a given trial, with one of the alternatives

occurring more frequently than the other, the results indicated that this hypothesis was supported.

Westrope (76:515) investigated the relationship between manifest anxiety (as measured by the MAS) and Rorschach measures of anxiety and control and digit performance under stress (produced by the introduction of an audience and by administration of electric shock). Although the stressor significantly impaired performance, there was no significant relationship to anxiety, as measured by the MAS and the Rorschach test. Four of the Rorschach indices of anxiety differentiated between the MAS high- and low-anxious subjects.

Summary. In verbal learning tasks, the majority of studies investigating the relationship between anxiety and performance have noted an interactive effect between anxiety level and task difficulty. In "low difficult" tasks, high-anxious subjects were found to be superior to low-anxious subjects (33,34,40,50,53,61,63,67,68) while low-anxious subjects were observed to be superior to high-anxious subjects in tasks of high difficulty (28,33,34,40,50,53,54,61,63,68,69,74). Only Korchin and Levine (28) and Sarason (52) were unable to verify the former result while Taylor (67) and Lazarus,et al (30) failed to verify the latter finding.

Davidson, et al (11) and others (50,52,74,76) indicated that the anxiety classification as such did not produce differential effects on performance but seemed to serve as a

"priming" function for other stress effects. However, this is contrary to the findings of Lee (33) and others (28, 33,34,40,61,63,67,68,69). Lee (33) concluded that " . . . anxiety as measured by the MAS should be considered chronic, i.e., present in experimental situations regardless of the presence of shock."

Effect of Stress and the MAS on Psychomotor Learning and Performance. Farber and Spence (14:120) attempted to determine whether there was any difference in the performance of eighty high-and low-anxious subjects on a ten point linear T-maze. They noted that the high-anxious subjects were significantly inferior in maze performance, both for trials and errors, with the greatest difference in errors being found at the more difficult choice points.

However, Axelrod, et al (1:131) used ninety-six high-, middle and low-anxious subjects on the identical apparatus and with the same procedure but failed to find any significant differences among anxiety groups with respect either to total errors or trials to the criterion. Also, no significant relationship was found between either of the two groups and choice point difficulty.

Grice (20:71) administered the Air Force Discrimination Reaction Time Test to sixty high-and low-anxious subjects to determine which of the two groups would react better in a situation in which there was a high degree of interference (competing habits). Grice states,

While the low-anxiety group was superior in performance on the reaction time task, it was found that this superiority could be attributed to intellectual differences rather than to differences on the level of anxiety. (20:74)

Price (43) considered the interactive effect of neutral and failure comments of performance induced success and failure with two extreme anxiety levels from the MAS during the performance of a motor learning task. All these variables were assumed to have the multiplicative property of drive with respect to habit strength. Two preliminary tasks (standard turret pursuit rotor and reversed turret pursuit rotor) were given before the criterion task (epicyclic pursuit rotor) was administered. It was suggested by the author that the high anxious subjects would show superior performance on the standard turret pursuit rotor apparatus because the task offered more opportunity for facilitation than for interference but, low-anxious subjects would be more proficient on the reversed turret pursuit apparatus because the task was evaluated as extremely difficult, offering more opportunities for interference. Prior to taking the criterion trial the various groups were subjected to verbal (from instructions) and performance (from performance itself) induced failure. The criterion task was judged to be somewhat more heavily weighted with opportunities for interference than facilitation and therefore low-anxious subjects should perform more successfully on this task than high-anxious subjects.

Although none of the results was statistically significant, they all tended to fall in the expected direction. It was further observed that verbally induced failure introduced between the preliminary task and the criterion task produced no recognizable effects upon the performance of the criterion tasks. Some of the reasons which Price advances as a possible explanation for her results to support the hypothesis are (43:94):

- 1) The standard turret task was evaluated as weighted with opportunity for facilitation and the hypothesis was set up that high-anxious should produce superior performance scores. However, comparison of the data from this test (using women) with tests using men leads to the suggestion that this task may be relatively easier for males and does not provide the expected opportunities for facilitation as postulated.
- 2) Verbally induced failure may not have affected the subjects because the experimenter was of the same sex as the subjects.
- 3) The third explanation may lie in the possibility that such response tendencies as may have been induced by the verbal failure may have had as yet unsuspected relationships relative to the tendencies essential to performance on the epicyclic task.

Truax (72) analyzed the performance of high- and low-anxious subjects in a switch turning task which investigated separately the travel and manipulation components. It was noted that high-anxious subjects spent more time manipulating and less time travelling in the same task as do low-anxious subjects. It was further observed that with an increase in task complexity, high-anxious subjects showed an increase in errors while the low-anxious group was not affected.

Ryan and Lakie (48) hypothesized that persons with high need-achievement (as measured by the French Test of Insight) and low-anxiety (as measured by the MAS) would perform better in a competitive situation than persons with low need-achievement and high-anxiety. The subjects were given a ring-peg test to measure performance and then after a success report they competed with the experimenter who was reported to be of equal ability. The authors concluded that,

The results of this study substantiate the hypothesis that when desire to succeed, as measured by need-achievement is greater than the fear of failure, as measured by the MAS, competitive performance is improved. (48)

Summary. The results of the studies relating Manifest Anxiety Scale scores to performance in motor tasks have not been as conclusive as those studies of verbal performance and the Manifest Anxiety Scale. Only a small number of studies have been carried out in this area and the findings from these have either been insignificant (20,43) or, as in the case of two studies (1,14), in complete contradiction to each other. More studies are needed in this area before any definite conclusions can be reached.

The Effects of Stressors on Verbal Learning and Performance. Using one hundred and fifty-eight fifth grade subjects, Castaneda and Palermo (9:175) investigated whether speed stress had a deleterious or beneficial effect on changed and unchanged S-R elements of a paired-associates type task. On the initial learning trial, the subjects learned a number of paired-associates to criterion and then,

on the second test trial, certain pairs of S-R elements were changed. The authors postulated that " . . . if performance to the unchanged pairs is considered, the effect should be facilitation" (9:175). This hypothesis was supported. In the case of the changed S-R pairs (dominant habit incorrect), the general effect of an increase in drive was deleterious with the tendency for this effect to be augmented by increases in the strength of habit, while in the case of the unchanged S-R pairs (dominant habit correct), the effect of an increase in drive for the strong habit groups was in the direction of facilitation. These results were confirmed by Castaneda (7:9) in a similar follow up study.

Bardach (2:420) administered unavoidable electric shock to two groups of seventeen male undergraduates who were learning nonsense syllables of low association value on a Patterson memory drum. The first group was shocked after learning thirty percent of the list and the second, after learning seventy percent of the list. The results indicated that only the latter group showed any impairment of performance, which is contrary to what might be expected by virtue of the drive theory.

The results of a study by Lazarus and Eriksen (32:100) indicates that there was a wide degree of individual variability in performance under stress; some subjects being unaffected whereas others showed significant increases or decreases in their performances. The authors administered

the Wechsler-Bellevue Digit Symbol sub-test to one hundred and eighty-eight college students. The subjects were told that the test was an excellent predictor of college success. After the initial test one group was taken aside and told that it had failed; the other group was informed that it had passed. Both groups were then given a second test and during this test, two sets of false norms were introduced, one of which was readily accessible, and this was applied to the "success-informed" group. The "failure-informed" group worked under standards which were impossible to attain. Both of the experimental groups showed an increase in errors, while the control group showed a decrease, with the differences in the change in errors being statistically significant. There was a tendency for students with high grade-point averages to improve their performance under stress while students with poorer academic standings, although more variable, had a tendency to deteriorate under stress.

McKinney, et al (37:316) also noted a large individual variability to stress. A reporting test ". . . which required rapid discrimination and counting of figures in a series of circles" (37:316) was administered to one hundred and ninety-six naval radar-operator trainees. After an initial performance, failure stress was added to the speed stress when subjects were told that they were failing to meet a standard of performance. While the majority of subjects attempted more problems and made more errors at this point, a smaller group of subjects showed stable performance

without increase of speed or errors. However, Sarason (50:253) and Davidson, et al (11:13) found that failure report or stress resulted in significant decrements in performance.

Kohn (27:289) observed that the ability to learn and recall under experimentally induced stress varied inversely with the amount of stress. In two studies, male and female undergraduates studied either a picture or a detailed story under one of three stress conditions: a) threat of electric shock, b) conditions of distraction, or c) normal environmental conditions. In both situations, efficiency of reproduction was least under the electric shock threat and greatest under the normal and distraction conditions. In the detailed story, both irrelevant and relevant items were reproduced less accurately under conditions of threat stress than in the low emotional intensity situations. Also, there was a tendency for irrelevant items to be omitted more often than relevant items when the subject was under the shock threat conditions. Kohn (27:302) concludes:

The results seem to justify the general conclusion that severe emotional stress reduces the score of a complex perceptual activity and it is tentatively suggested that the disruptive influence of emotion tends to be localized in the irrelevant or less important aspects of a perceptual task rather than in the relevant items.

This study is supported by the results of a study by Glixman (19:281) dealing with the recall of completed or incompleted activities under varying conditions of threat to the self-esteem of the subjects. He noted a significant decrement in the recall of incompleted items as stress in-

creased.

Lanzetta (29:67) indicated however, that subjects under low stress performed better than subjects under high stress; the relationship of performance to stress being parabolic.

Beam (6:543) and Eichler (13:344) noted that an increase in stress resulted in an increase in errors. Eichler administered electric shock randomly to subjects involved in an experimental subtraction test while Beam used real life stress situations (tested immediately prior to doctoral examinations, the presentation of oral reports and the appearance in a dramatic presentation). The results indicated that subjects under stressful conditions made one and one-half the errors and required one and one-half the trials to reach the criterion of mastery as they did under neutral conditions.

Summary. In studies dealing with the effect of stress upon verbal performance Lazarus and Eriksen (32) and McKinney, et al (37) noted that there was a large degree of individual variability under stress while Beam (6), Eichler (13) and others (19,27) observed that the introduction of stress resulted in a decrement in performance. In support of the drive theory, Castaneda and Palermo (9) found that when the dominant habit learned was incorrect, the introduction of stress was beneficial to performance. Contrary to this finding and drive theory expectations, Bardock (2) observed that only the group shocked late in the learning process

showed any impairment in performance.

Effect of Stressors on Psychomotor Learning and Performance. Ryan (46:111)(44:103), in two different studies, investigated the interactive effects of stress and learning, in difficult and easy tasks, early and late in the learning process. In his first experiment (46:111) he tested the hypothesis that externally induced tension would facilitate performance on a relatively easy motor skill but impair performance on a more difficult motor skill. One hundred and twenty male university students were tested on a stabilometer. The degree of difficulty was altered by varying the vertical position of the balance platform in relation to its center of rotation, and stress was applied by random administration of an electric shock. Two of the groups (one performing the "easy task", the other in the more difficult) were shocked, beginning with the first performance trial, while another group which performed the more difficult task was shocked randomly, beginning with the third of twelve performance trials. The results supported one part of the hypothesis, i.e. that shock would impair performance in a difficult task, but failed to support the hypothesis that tension would improve performance in an easy motor task.

In a follow up study, Ryan (44:303) used the same difficult task to try to determine if performance would show the same deleterious effects late in learning because of the stressor that it did early in learning. Thirty 12 second

trials were given for five days, with one session for practice per day. The experimental and control groups underwent identical conditions until the fifth day, when the subjects in the former group were told that they were going to receive a strong unavoidable shock. It was found that stress, which impaired performance in the difficult task during the first practice period (46:111) had no effect on this skill after four practice periods, thus lending support to the drive theory.

In another study, Ryan (47:279) used the GSR and ranked subjects on the basis of initial conductance, final conductance, total change in conductance from rest to the final trial, conductance after trial one, and changes in conductance from rest to trial one. The subjects were dichotomized into equal groups called 'high arousal' and 'low arousal' on the basis of their conductance scores. The analysis of the data indicated a relationship between arousal and performance on the stabilometer with the high arousal groups having performance scores superior to the low arousal groups. It was also observed that the interaction of Trials X Groups was significant for trials one to six, indicating that the performance of the high arousal group improved at a faster rate than that of the low arousal group.

In a study using a paired-associates type of motor task, Castaneda and Lipsitt (8:25) examined the effect of speed stress on learning and performance. The apparatus was design-

ed so that one-half of the to-be learned S-R combinations would involve a 'dominant position habit' (preexperimentally acquired), while the other one-half of the responses would not. It was assumed that the effects of stress would interact with the particular S-R combinations involved and for those combinations in which the initially dominant response was compatible with the correct one, performance under stress would be facilitated in comparison to non-stress but impaired where it was incompatible with the correct response. The results tended to support this hypothesis. The stress group, in comparison to the non-stress group, made more correct responses on the 'dominant trait correct' combinations at all stages of training and with the exception of the last block of trials (when possibly the habit strength of the correct-called-for-response became stronger than the incorrect response), fewer correct responses on the 'dominant habit incorrect combinations.

Saltz and Riach (49:588) noted a decrement in the performance of male and female college students in a paired-associates psychomotor task as a result of electric shock applied late in the learning process. However, analysis of the results pointed out that subjects who were at the high levels of performance prior to the shock showed little decrement. Most of the decrement was contributed by subjects who had learned the discrimination to a relatively low (but greater than chance) criterion. Within this group, there was

also a significant difference between stimuli which overlapped and those which did not, with the overlapping stimuli groups (difficult discrimination) showing more decrement than the non-overlap groups.

Barlow (3:478) found that when mirror tracing of a six-point star was the task, both male and female subjects took a longer time to reach the criterion of learning when mild electric shock was applied as a punishment for errors. He did find that the number of errors decreased however during the task. Because there was no speed stress or motivator involved it is difficult to gauge these results.

Crafts and Gilbert (10:73) investigated the effects of punishment (in the form of electric shock) for errors upon the learning of a stylus maze. The experimental group learned the McGeoch-Melton medium maze to the criterion of two out of three successive trials without error. Every error (contact with the end of the cul-de-sac) resulted in an electric shock. Although there was no significant difference between the experimental group and control group in retention, the former group was superior in terms of trials and time to the criterion. Also, in relearning, the male experimental group was slightly superior to the controls while the female experimental group was markedly superior to the control group.

Gilbert and Crafts (18:121) compared the above results which used shock for error during learning with the results obtained using an auditory signal for error. The same

apparatus and procedure were used except that contact with a cul-de-sac resulted in a buzzing sound. Again, the experimental group was superior to the control group according to all the criteria. Commenting on this superiority, Gilbert and Crafts (18:132) estimated,

Its superiority in learning was attributed to the unquestionable guidance or informative value of the auditory signal together with the punishment and incentive functions which it probably also possessed. Comparison of the signal and shock groups showed the value of shock and sound for both learning and retention to have been approximately equal. The guidance value of these two stimuli may be considered identical and perhaps the disturbing effect of shock on some subjects counterbalanced its presumably greater significance as an incentive and as a punishment.

McTeer (38:453) also used electric shock for error in finger maze performance. He observed that the punished learners mastered the maze to the criterion with fewer trials and fewer errors than the control group. More significant perhaps, the experimental group, despite its initial caution and slower approach to the problem, learned the maze to criterion in the same amount of time.

Gilbert (17:456) compared the effects upon stylus maze performance of electric shock for error given in such a way as to eliminate the guidance factor from the results from two previous studies using electric shock (10:73) and buzzer signals (18:121) as indicators of error. During the first half of learning, an electric shock was given for every ten errors, and later it was applied after every five errors. This procedure resulted in the experimental group using more

trials in learning the maze to the criterion of two out of three successive trials without error, but they were superior to the control group in time taken and errors in learning. However, this "non-informative shock" group is inferior to the other experimental groups of the previous studies (10:73)(18:121) in point of trials and errors and only equal to them as regards time.

Gurnee (21:354) considered the effect of electric shock for right responses and compared this experimental procedure with the administration of electric shock for wrong responses, in a maze learning situation. Two intensities of shock were applied for both conditions and analysis of results revealed that the most effective procedure was the administration of light shock for a right response, while the least effective was the administration of heavy shock for right responses. Also, light shock for wrong responses was found to be superior to heavy shock on wrong responses.

In two individual studies, Muenzinger (41:439), and Muenzinger and Vine (42:67) did not observe any significant difference between the group that was shocked for right answers and the group that was shocked for wrong answers. Muenzinger (41:439) also compared "bell-right" and "bell-wrong"; "shock-right" and "no-shock"; and "shock-wrong" and "no-shock" and no significant differences were found.

However, Feldman (16:171) supports the results of Gurnee (21:354) who found that when shock intensity was low, "shock-right" was the superior condition. Contrary

to Gurnee's findings, however, Feldman reported that when shock intensity was high, "shock-wrong" tended to be the superior condition in this finger maze task.

Travis and Anderson (71:101) examined the performance of subjects operating under shock stress. Fifty-five subjects were tested on the pursuit rotor in three different groups: a) control, no shock, but motivated, b) shocked for every error and c) shocked for every error only on trials two, four, six and eight. An error consisted of lost target contact. There was a slight but non-significant difference in favor of the experimental groups over the control groups. In analyzing the data, the authors noted that the alternately shocked group performed better in the shocked trials than in the non-shocked trials whereas the results of the group shocked every trial were consistently lower than the control or alternately shocked groups. Travis and Anderson (71:106) suggest that these two points, " . . . are contradictory, and presumably point to the hypothesis that the persistence of electric shock is disrupting to learning, whereas its occurrence during alternating trials is facilitative." (71:106). As a result of a follow up study, Travis (70:427) concludes:

It is evident that electric shocks and monetary rewards of the character that were employed have some effect on learning in hand-eye coordination, either as a slight disruption or a slight reinforcement. The general form of the learning curve however, seems to remain about the same regardless of the shocks or the rewards.

Zimny (77) observed no differential effects for three different motivating conditions (threat of electric shock, report that the task was a test of intelligence and an incentive condition) in a paced experimental verbal learning task; learning of nonsense syllables on a memory drum. However, when the subjects were tested in card sorting, a non-paced task, under any of the three conditions, there was a significant facilitating effect upon mean performance. This effect appeared most noticeably immediately after the presentation of the motivation condition but was not as apparent when performance on the entire task was considered.

Ryan (45:83) compared the effect of three motive-incentive conditions upon the hand dynamometer performance of eighty male university students. After the initial control test (which indicated that there was no significant difference between the subjects or groups) the subjects were equated into one of four groups: a control group; a 'verbal' group which was encouraged verbally to improve on its previous score; a knowledge of results group which was informed of its previous scores and encouraged to improve on them; and a 'shock' group, which also knew its initial score and was informed that failure to equal or surpass this score would result in a shock. Analysis of the results indicated that although the " . . . scores for the shock group are considerably higher . . . the differences between groups are not significant." (45:83)

McKinney (36:101) investigated the effects of failure stress on stylus maze learning, learning of nonsense syllables on a memory drum and performance on a steadiness test and in multiplication problems. The introduction of the experimental condition produced a consistent increase in errors in the maze learning, multiplication and steadiness tests over the control condition. McKinney(36:114) concludes,

The experimental results evince that emotion affects learning and that a strong emotion cannot act as a motive in an intellectual task or skill.

McClelland and Apicella (35:159) dealt with the problem of failure-stress in varying sequences. They observed that stress caused by false failure-scores resulted in more trials to reach the performance criterion.

Kelman (24:267) examined the effects of success, failure, ambiguous and neutral reports on suggestibility in a subsequent autokinetic situation. He points out (24:267):

. . . suggestibility scores differ as a function of the different reinforcement procedures. The 'failure' group was higher, the 'success' group lower suggestibility scores than the 'control' group. The 'ambiguous' group is not significantly different from the 'control' group.

Variability of scores in the second test revealed that the success and failure groups tended to show a decrease while the control group showed an increase in variability.

Kendler (25:79) and Marrow (39:3) observed that a significantly greater number of items associated with success are recalled than are items associated with failure.

Bayton and Whyte (5:583) found that a success-failure sequence produced poorer results than a sequence of failure-success on the Minnesota Rate of Manipulation Test. However, Lazarus, et al (30:293), commenting on these results, point out, that ". . . because they failed to include a control group it is impossible to decide whether the differences in performance between the conditions are due to success, failure, an inter-action between these, or sampling error".

Success and failure reports, used as motivational stressors, were found by Ulrich and Burke (73:403) to be better than neutral comments or omission of the stressors for increasing work output on a bicycle ergometer. Eighteen male and female university students were subjected to three work bouts on a bicycle ergometer. On the first trial, they were told to do their best, while on the second trial they were informed that they would hear a buzzer if their performance was not up to trial one standards, and on the third trial a buzzer would go off if their performance was above their previous level. Although both motivational stressors were found to influence performance significantly, the success report was significantly better than the failure stressor for increasing work output.

Johanson (23) and Howell (22:22) noted that the administration of electric shock produced shorter reaction times. Howell used a motor task which consisted of hitting a ball, reversing direction to touch a key, and then hitting a second ball. After the initial performance, the subjects

were told that they would be shocked if their performance was not better than on previous trials. The group performing under the electric shock stress exhibited a significantly greater increase in speed of the motor performance than was observed in less tense subjects.

However, Farber and Spence (15:1) using a reaction time measure consisting of moving from a starting key to a response key found that threat of electric shock caused no significant improvement in scores. They also used the Taylor MAS and no differentiated effect was noted between the high-and low-anxiety subjects.

Summary. The effects of stress upon motor learning and/or performance are not clear. Some experimenters have noted that the introduction of a stressor has produced a facilitative effect upon performance (3,10,17,18,22,23,38,73); others have observed a decremental effect (35,36,49); while still others have found that the introduction of a stressor had no significant effect upon performance (15,41,42,45,77).

The results of studies investigating drive theory have, to a certain degree at least, been in unison in their support of this theory. Ryan (46,44) observed that while a shock stressor impaired performance in a difficult task when it was introduced early in the learning process (46), it had no effect on performance when it was introduced late in the learning process (44). Castaneda and Lipsitt (8) found that stress interacted with the S-R combination. When the

initially dominant habit was correct, performance under stress was facilitated but when the initially dominant habit was incorrect, stress impaired performance.

Ryan (47) found that high arousal subjects learned a task significantly faster than low arousal subjects but since no evaluation of habit strength is possible, it is difficult to draw implications for the drive theory.

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CHAPTER III

METHODS AND PROCEDURES

Selection of Subjects. The Taylor Manifest Anxiety Scale (MAS) was administered to the total first year University of Alberta (Edmonton) male population. Of the one thousand two hundred and seventy-two students tested, two hundred and five fitted the criterion of low-anxious (i.e. scored seven or below on the MAS) while two hundred and eight were classified as high-anxious (i.e. scored twenty-one or above on the MAS).

After the responses of the two hundred and five low-anxious and the two hundred and eight high-anxious subjects were analyzed on the L-scale of the MAS, approximately one hundred high-anxious and one hundred low-anxious individuals were preselected as possible subjects. The one hundred and twenty subjects eventually chosen were selected on the basis of their availability to the experimenter. When the subjects came in to be tested, they were assigned (according to a fixed order) to one of three groups (see Table 1.):

a) Control Group - The subjects in this group practised for two days (seventy trials) on the stabilometer under the identical conditions experienced by the two experimental groups except that they were not exposed to the experimental stressor. The Control group was composed of forty subjects; twenty high-anxious and twenty low-anxious.

b) Stress Early Group - The subjects in this group were placed under stress early (trials four to six, Day 1) in the learning process. The Stress Early group was composed of twenty high- and twenty low-anxious subjects.

TABLE 1.

Experimental Design

Group	n	DAY 1		DAY 2	
		Trials	Condition	Trials	Condition
Control	20 HA and 20 LA	T ₁ -T ₃₅	normal (no shock)	T ₃₆ -T ₇₀	normal (no shock)
Stress Early	20 HA and 20 LA	T ₁ -T ₃	normal	T ₃₆ -T ₇₀	normal
		T ₄ -T ₆	shock stress		
		T ₇ -T ₃₅	normal		
Stress Late	20 HA and 20 LA	T ₁ -T ₃₅	normal	T ₃₆ -T ₆₄	normal
				T ₆₅ -T ₆₇	shock stress
				T ₆₈ -T ₇₀	normal

c) Stress Late Group - These subjects had more opportunity to learn the task before they were subjected to the stress. The electric shock was introduced on trials sixty-five to sixty-seven. This group also contained forty subjects (twenty-high- and twenty low-anxious)

Apparatus. The apparatus used in this study were:

Stabilometer. (see Figure I) This instrument consisted of a horizontally pivoted one inch plywood platform forty-eight inches long by twenty-four inches wide. Connecting steel rods from the platform were united to supporting steel uprights which in turn were attached to and supported by a heavy steel base. Rotation of the platform was provided for by pillar blocks mounted in the supporting uprights. The center of rotation was ten inches above the platform. Each trial lasted a duration of twenty seconds.

The range of motion of the platform was $\pm 20^{\circ}$ from the horizontal. Motion of the board over this arc was measured in electrical "movement units". This electrical recording was provided by a segment of forty circular contact points with carbon brushes which provided electrical impulses with the back and forth movement of the platform over the contact-segment (the 40° arc). These impulses were recorded on an electrical counter with 1° of movement represented as one "movement unit".

The task of the subject was to keep the platform in a state of balance on or at any point along the rotation axis. A subject started a trial with the stabilometer platform resting on the limit stops at the right hand side (facing the counting and timing devices) of the base. The subject stood erect on the platform, straddling the middle axis, with his feet placed on two fixed eighteen and one-half by

twelve inch rubber placement mats set. The mechanical-electrical timing and recording system was re-set at the 'start' position at the commencement of each trial. The system was activated when the subject made his first movement to balance the board. The starter introduced the electrical timer and recorder by means of a microswitch.

With the start of the timer a separate circuit was introduced in series which recorded the degrees of movement in "movement units" on an electrical counter.

To insure that each twenty second trial period represented that much actual balancing time, microswitches, wired in series, with the electrical timer, were placed in such a way that when the platform was resting against the supporting base, no time elapsed.

Model 250 Constant Current Electronic Stimulator. This apparatus consisted of a portable eight and one-half by six and one-half by eight inch cabinet which operated on four controls: continuous or intermittent wave train on either a 0-500 ua. or 0-5 ma. range. During the experiment the experimental subjects were exposed to a continuous wave train on the 0-5 ma. with all subjects receiving the former stimulus as their first shock. The magnitude was increased subjectively for subsequent stimuli according to how the experimenter perceived the subject's stressed state. During the presentation of a shock stimulus the continuous wave train was maintained until the needle of the calibrated scale reached a peak or the maximum of its intensity. The

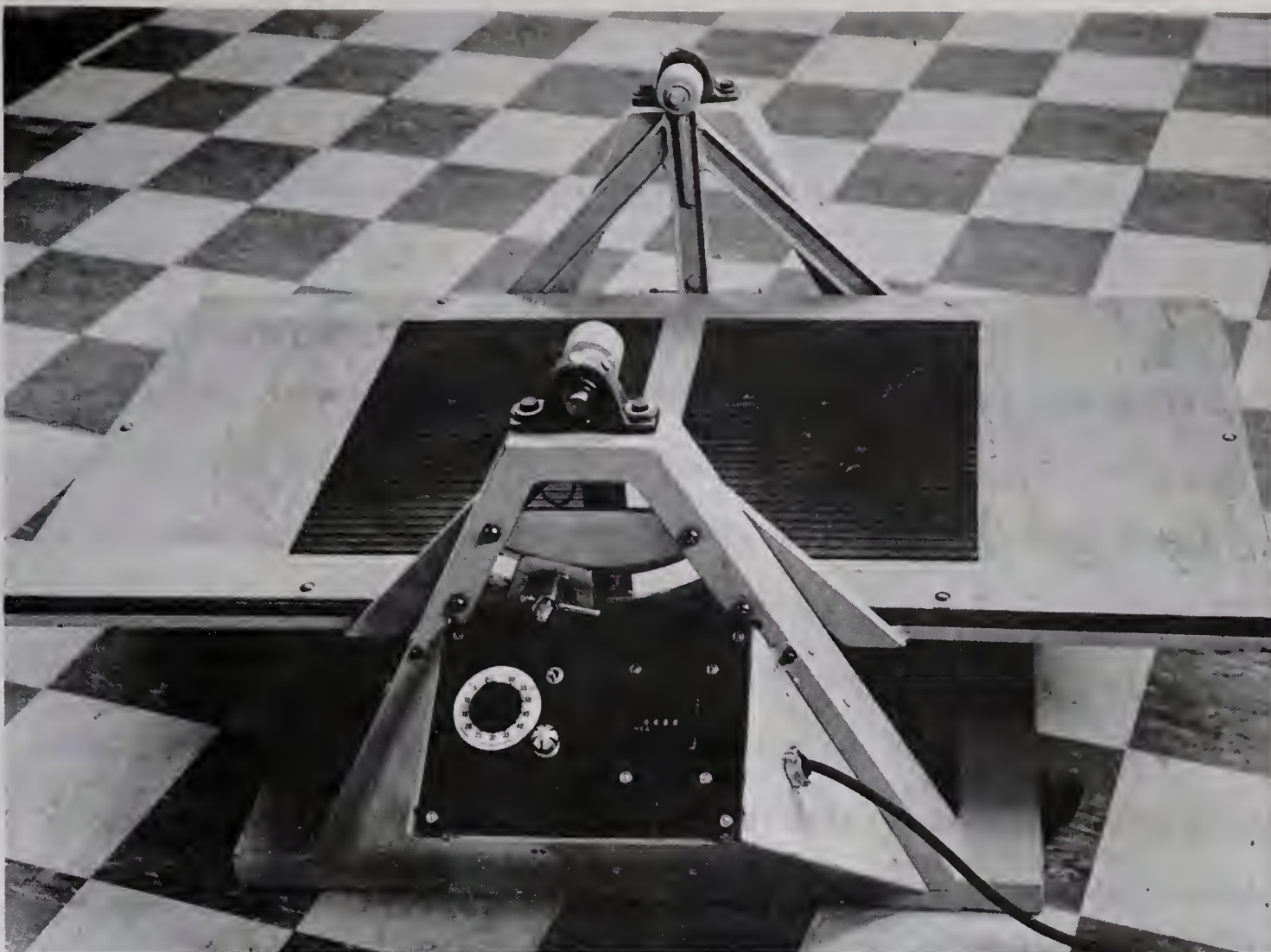


Figure I. The Stabilometer



Figure II. The Model 250 Constant Current Electronic Stimulator

repetition rate of the stimulator was 60 per second and the pulse duration 1/120 second.

Testing Procedures. The subjects were called into the laboratory from their physical education class and asked to participate as subjects in a "balance learning experiment". In answer to subjects' queries, it was stated that their names were picked in a random order from their instructors' roll call list and they did not have to participate in the experiment if they were not interested. No prospective subject declined to participate at this point. The methods and procedures of the experiment, including the approximate length of testing periods, the balance technique and foot placement on the stabilometer, and the testing schedules were explained at this time. No mention was made of the electric shock stressor. The subject was told that he would perform on the stabilometer with bare feet because of the greater control provided. Only one subject was tested per session and no spectators or waiting subjects were allowed in the laboratory during the course of the experiment.

When the subjects arrived at the laboratory on Day 1 they were arbitrarily placed into an experimental or control group according to the preconceived order of "Control-Stress Early-Stress Late".

On Day 1 of the experiment the Control and the Stress Late subjects were given thirty-five 20 second trials on the stabilometer with a rest period of twenty to thirty seconds interspersed between each learning trial. At the conclusion

of the thirty-five trials, the subject's height, weight and age were determined and a second test session was arranged. No knowledge of results was given any subject until the end of the seventieth trial on Day 2.

The Stress Early group was given three normal or control trials on Day 1 and then, before trial four, it was explained that the conditions of the experiment necessitated that they receive a number of unavoidable electric shocks over the next three trials. The subjects were given the option of withdrawing from the experiment at this point if they wished. During the total experiment three subjects refused to be shocked: two stress early; one high- and one low-anxious; and one low-anxious stress late. They were dropped from the experiment.

The finger electrodes were then placed on the right index finger of the subjects and they were informed that over the next three trials they would receive either zero, one, two or three electric shocks per trial. It was emphasized that these shocks were unavoidable and were in no way related to performance. On trial four (the first stress trial) all subjects received only one electric shock, at the fifteen second mark of the twenty second trial period. This shock proved to be mild for the majority of subjects but it was given late in the trial. It was felt that by giving this first shock late in the trial the subject would still be sufficiently stressed from the threat of shock for the first trial and some indication would be available as to the subject's

threshold for electric shock. The severity of the shock was then increased in an arbitrary fashion dependent upon the reaction of the subject in trial four. In all cases, however, an effort was made to keep all subjects in a stressful state for trials five and six. Immediately after trial four, the experimenter remarked that a mistake had been made and the electric shock which had been too mild would be increased in intensity for trial five. The experimenter then turned the dial of the 'stimulator' so the subject could see the intensity being increased.

On the next two trials two electric shocks were given per trial: one at the five second mark and one at the ten second mark of each twenty second trial period. This is illustrated in Figure III. At the end of the sixth trial the finger electrodes were removed and the Stress Early group was given another twenty-nine trials under normal conditions. (Figure IV). At the end of the thirty-five trials on Day 1 the height, weight and age of the Stress Early subjects were determined and a second test session was arranged.¹ The subjects were requested not to discuss the experiment and the experimental conditions outside the laboratory. Despite the emphasis placed on the need for secrecy in relation to the electric shock stressor some subjects talked about the experiment outside the laboratory. When questioned at the end of

¹ The delay between Day 1 and Day 2 testing varied from one to seven days, depending upon the class schedule of the subject.



Figure III. A Subject Under Control Conditions Balancing On The Stabilometer



Figure IV. A Subject During An Experimental Stress Period Balancing On The Stabilometer.

the seventy trials three subjects (all Control: two high- and one low-anxious) reported that they had had prior knowledge of the electric shock component of the experiment. Their results were discarded.

On the second day of testing, the procedure followed was basically the same as for Day 1 except that the Stress Early and Control groups were now given the thirty-five twenty second trials with a twenty to thirty second rest interspersed with no experimental conditions applied. The Stress Late Group however was given twenty-nine trials and then before trial sixty-five they were informed that the experiment required that they be given either zero, one, two or three unavoidable electric shocks per trial for the next three trials. The methods and procedures regarding the number of shocks given per trial, the severity of these shocks, the times at which they were given and the experimental instructions during the stress periods were as closely identical to Day 1 as possible. At the end of the three stress trials the Stress Late group was given their last three trials under normal conditions.

CHAPTER IV

RESULTS AND DISCUSSION

Results. For purposes of convenience and clarity of reporting of the results, the following definitions are used: high-anxious (HA); low-anxious (LA); stress early (SE); stress late (SL); control (C); Taylor Manifest Anxiety Scale (MAS); and subjects (Ss).

In computing the learning score (which is here defined as initial score minus final score) an average of three trials is used as the representative number for the initial score and the final score. In addition, since the stress periods were three trials duration, the numbers representing these periods are also an average of three trials. In the graphic representation of the learning curve (Figure VI), each trial is a composite of three actual performance trials. Due to the fact that only seventy trials were given, two trials (trial ten and trial twenty) represent an average of two performance trials only.

The Selection of Subjects. The frequency distribution and percentages for the first year University of Alberta male population tested on the MAS are reported in Figure V and Table II. Of the one thousand, two hundred and seventy-two students tested, two hundred and five fitted the criterion of LA (i.e. scored seven or below on the MAS) while two hundred and eight were classified as HA (i.e. scored twenty-one or above on the MAS).

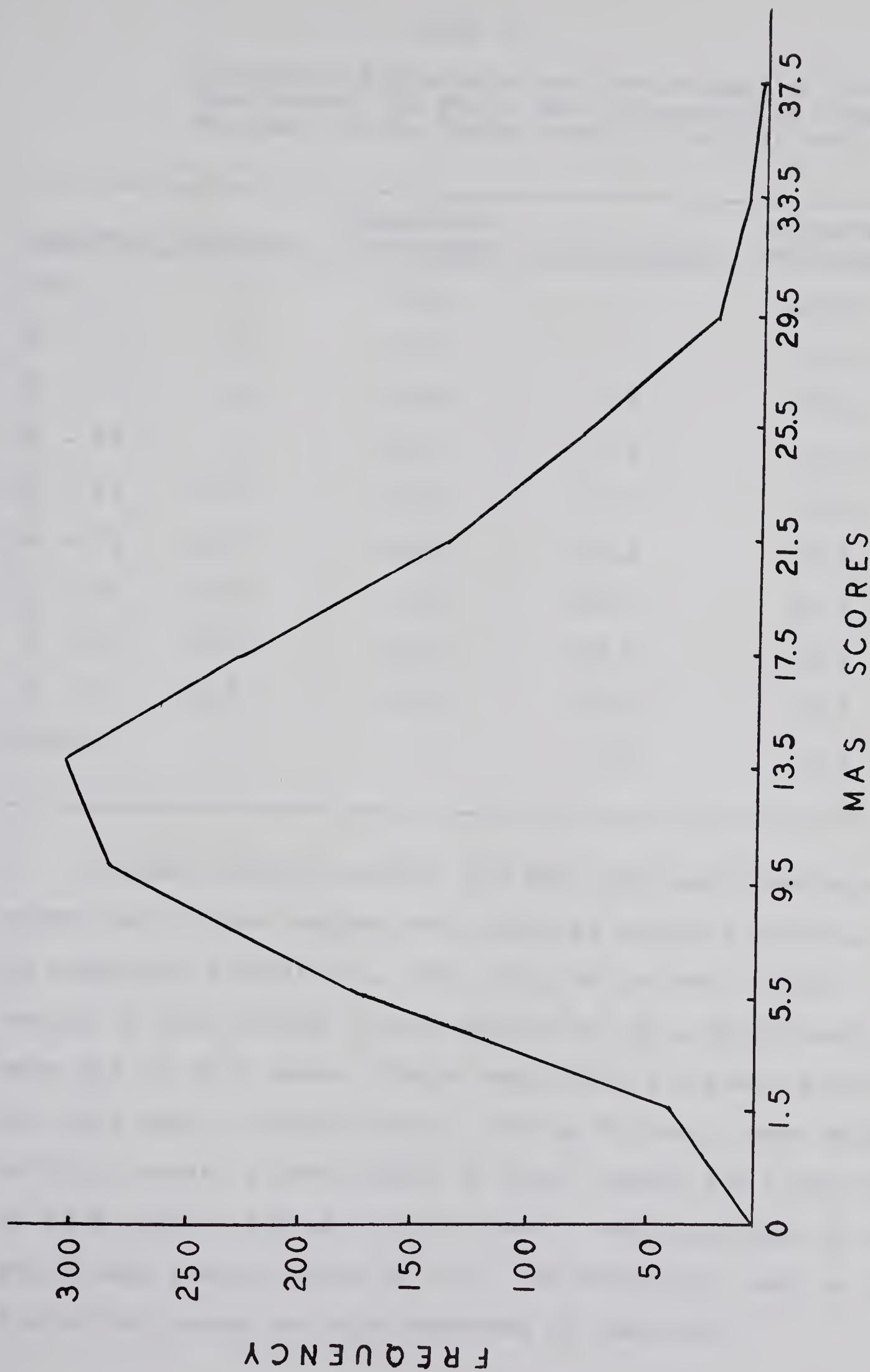


FIGURE V. Distribution Of Manifest Anxiety Scale Scores For One Thousand, Two Hundred And Seventy-Two University Of Alberta Male Freshmen.

TABLE II

Cumulative Frequencies and Percentages of the Test Scores for First Year University of Alberta Freshmen on the Taylor Manifest Anxiety Scale.

Interval	Frequency	Cumulative Frequency	Percentages	Cumulative Percentage
over 35	1	1272	.1	100.0
32 - 35	11	1271	.9	99.9
28 - 31	23	1260	1.8	99.0
24 - 27	73	1237	5.7	97.2
20 - 23	140	1164	11.0	91.5
16 - 19	232	1024	18.2	80.5
12 - 15	302	792	23.8	62.3
8 - 11	285	490	22.4	38.5
4 - 7	168	205	13.2	16.1
under 3	37	37	2.9	2.9

The mean height, weight, age MAS score and Lie-Scale score for the one hundred and twenty Ss actually tested, is reported in Table III. The sixty HA Ss have a mean height of 69.4 inches, a mean weight of 156.1 pounds and a mean age of 18.8 years. Their mean MAS and L-scale scores are 26.1 and 3.0 respectively. The LA Ss have a mean height of 69.6 inches, a mean weight of 156.7 pounds and a mean age of 18.8 years. The LA subjects have a mean MAS score of 4.9 and a mean L-scale score of 3.8. The values for each of the individual groups are also reported in Table III.

TABLE III

Mean Age, Height, Weight, and Manifest Anxiety Scale and Lie-scale Scores for
The One Hundred and Twenty High- and Low-Anxious Subjects.

Group	n	MAS	L-Scale	Age (yrs.)	Height(in.)	Weight (lbs.)
HAC	20	26.5 \pm 4.1	3.0 \pm 1.4	18.9 \pm 2.1	69.4 \pm 2.6	153.8 \pm 19.2
HASE	20	26.0 \pm 4.0	3.2 \pm 1.9	18.6 \pm 0.9	69.0 \pm 3.9	158.1 \pm 15.8
HASL	20	25.7 \pm 0.6	2.9 \pm 1.6	18.8 \pm 1.9	69.7 \pm 2.4	156.3 \pm 23.9
LAC	20	5.0 \pm 1.8	4.4 \pm 1.2	18.8 \pm 1.3	70.1 \pm 2.0	156.9 \pm 14.4
LASE	20	4.9 \pm 1.8	3.7 \pm 1.1	19.1 \pm 0.2	69.2 \pm 3.3	163.1 \pm 15.9
LASL	20	5.1 \pm 1.8	3.3 \pm 1.7	18.6 \pm 0.7	69.5 \pm 2.3	150.0 \pm 12.8
HA	60	26.1 \pm 3.3	3.0 \pm 1.7	18.8 \pm 1.8	69.4 \pm 3.2	156.1 \pm 20.0
LA	60	4.9 \pm 1.8	3.8 \pm 1.4	18.8 \pm 1.0	69.6 \pm 2.7	156.7 \pm 15.4

During the experiment two Ss (one HA and one LA) refused to accept the shock conditions of the experiment and they were dropped from the study. In addition, three Ss in the control groups (two HAC and one IAC) reported at the conclusion of the test that they had had prior knowledge of the experiment (i.e. that shock was to be given) and consequently their results were also discarded.

The Effect of the MAS and/or Stress Upon Learning. The experimental design required all Ss to report for testing on two separate days. On both days each subject practised on the task for thirty-five trials of twenty seconds' work plus twenty seconds' rest. The learning curves for all six groups are represented in Figure VI.

Each trial on the graph is a composite of three performance trials. In analyzing the amount of learning, that occurred over the practice period, the subject's final score (average of the last three trials) is subtracted from his initial score (or average of the first three trials) to yield a learning score. The learning score is thus determined for Day 1, for Day 2 and for the entire seventy trials.

The amount learned on Day 1, on Day 2, and over the total seventy trials is in each case significant for all six groups. This is reported in Table IV. The difference between the groups in amount learned over the two days is not significant as shown by the anxiety level X groups analysis of variance (Table V).

When performance levels for all of the groups are con-

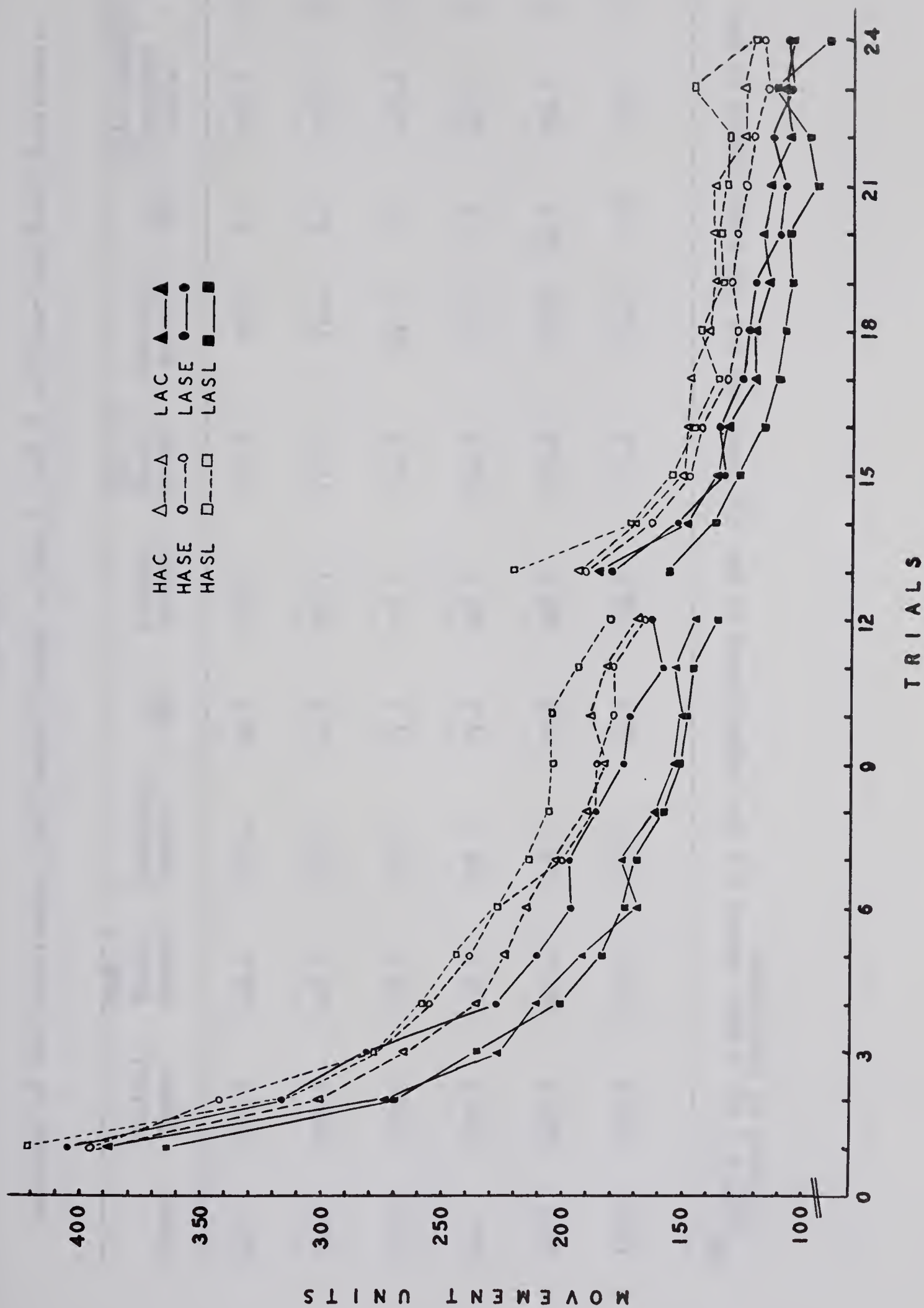


FIGURE VI. Learning Curves Of The Six Groups For Stabilometer Performance On Day 1 And Day 2.

TABLE IV

Learning of the Experimental and Control Groups on Day 1, Day 2 and Over the Total Experiment.

Group	DAY 1			DAY 2		TOTAL LEARNING	
	Initial Score	Final Score	Learning Score	Initial Score	Final Score	Learning Score	t ^a
FAC	395.4	169.0	226.4	12.7	197.9	78.0	7.9
HASE	396.8	165.7	230.9	12.8	192.3	74.4	8.6
HASL	421.4	179.3	242.1	11.5	221.4	100.6	6.7
LAC	388.6	145.5	243.1	13.6	186.1	79.3	8.1
LASE	405.5	163.1	242.4	12.2	180.3	71.5	10.7
LASL	364.8	135.9	228.9	14.2	156.4	65.8	2.52
							15.0

^a With $n = 20$, t must exceed 2.1 for significance at the .05 level and 2.9 for significance at the .01 level of confidence.

TABLE V

Variance Analysis of the Learning Scores for the Learning on Day 1, on Day 2 and for the Total Learning over The Two Day Period.

Source of Variance	df	Learning Score Day 1		Learning Score Day 2		Total Learning Score	
		(T ₁₋₃ - T ₃₃₋₃₅) MS F ^a		(T ₃₆₋₃₈ - T ₆₈₋₇₀) MS F ^a		(T ₁₋₃ - T ₆₈₋₇₀) MS F ^a	
Anxiety Level	1	749.50	0.19	4398.35	2.53	0.51	0.00
Experimental Condition	2	38.99	0.01	1044.30	0.60	955.44	0.22
Interaction (AL X EC)	2	2553.34	0.65	3895.74	2.24	4708.79	1.10
Error (within cells)	114	3930.92		1739.86		4279.31	
Total Sum of Squares	119						

^a For df 2,114 and 1,114, F must exceed 3.07 and 3.92 respectively for significance at the .05 level .

TABLE VI

Variance Analysis of the Initial, Final and Learning Scores for Day 1.

Source of Variance	df	Initial Score ($\overline{T_{1-3}}$)		Final Score ($\overline{T_{33-35}}$)		Learning Score ($\overline{T_{1-3}} - \overline{T_{33-35}}$)	
		MS	F ^a	MS	F ^a	MS	F ^a
Anxiety Level	1	9893.50	1.45	16086.93	4.66	749.50	0.19
Experimental Condition	2	983.61	0.15	648.77	0.19	38.99	0.01
Interaction (AL X EC)	2	11652.70	1.71	4138.05	1.20	2553.34	0.65
Error (within cells)	114	6802.82		3454.31		3930.92	
Total Sum of Squares	119						

^a For 1, 114 df, F MUST EXCEED 3.92 and 6.84 for significance at the .05 and .01 levels of confidence respectively.
For 2, 114 df, F MUST EXCEED 3.07 and 4.78 for significance at the .05 and .01 levels of confidence respectively.

TABLE VII

Variance Analysis of Initial, Final and Learning Scores for Day 2.

Source of Variance	df	Initial Score ($\frac{T_{33-35}}{MS}$) $F_{(a)}$	Final Score ($\frac{T_{68-70}}{MS}$) $F_{(a)}$	Learning Score ($\frac{T_{33-35} - T_{68-70}}{MS}$) $F_{(a)}$
Anxiety Level	1	26311.44	5.58	5.72
Experimental Condition	2	326.16	0.07	0.49
Interaction (AL X EC)	2	9377.49	1.99	0.77
Error (within cells)	114	4715.12	1608.37	1739.86
Total Sum of Squares	119			

(a) For 1, 114 df, F MUST EXCEED 3.92 and 6.84 for significance at the .05 and .01 levels of confidence respectively.
For 2, 114 df, F MUST EXCEED 3.07 and 4.78 for significance at the .05 and .01 levels of confidence respectively.

TABLE VIII

Duncan's New Multiple Range Test Applied to the
Differences Between $K = 6$ Treatment Means of
the Final Score (T_{33-35}) of Day 1.

Means	HASL 179.3	HAC 169.0	HASE 165.8	LASE 163.1	LAC 145.5	LASL 135.9	Shortest Sign. R α .05
HASL		10.3	13.5	16.2	33.8	43.4 [@]	$R_2 = 36.8$
HAC			3.2	5.9	23.5	33.1	$R_3 = 38.8$
HASE				2.7	20.3	29.9	$R_4 = 40.1$
LASE					17.6	27.2	$R_5 = 41.0$
LAC						9.6	$R_6 = 41.7$
LASL							

@ Significant at the .05 level of confidence.

sidered at various key points (average of three trials) in the total practice period, certain differences are apparent (Table VI and Table VII). There is no significant difference between any of the three group conditions or between the HA and LA levels on initial score on Day 1. However, in the Day 1 final score there is a statistically significant ($F = 4.66$, $p < .05$) difference between the HA and LA Ss. Therefore, while there is no difference in the amount learned, there is a difference in the final level of performance of the two anxiety groups on Day 1. This difference between the two anxiety levels is again evident on Day 2 (reported in Table VII).

On both the initial score ($F = 5.58, p < .05$) and final score ($F = 5.72, p < .05$) the significant difference between anxiety levels is maintained. Application of the Duncan New Multiple Range Test (5:136) to the ordered means of the above analysis is reported in Tables VIII, IX and X. For the final score on Day 1 (Table VIII) and the initial score on Day 2 (Table IX) the only significant difference indicated is between the means of the HASL and LASL groups. For the final score of Day 2 (which is also the 'post-stress period' of Day 2) there is a significant difference between the LASL group and all three of the HA groups (HAC, HASE and HASL). The relative positions of the groups remain unchanged from the final score, Day 1 (Table VIII), through the initial score (Table IX) and pre-stress period (Table XXII) to the final score on Day 2 (Table X). However, it is only in the final trials of Day 2 that the significant superiority of the LASL group is extended from the HASL group alone to all three of the HA groups.

Forgetting Between Day 1 and Day 2. When the Ss returned on Day 2 for their second set of thirty-five trials a significant ($p < .01$) amount of forgetting had occurred for all six groups (Table XI). When the forgetting score (defined as the initial score of Day 2 minus the final score of Day 1) is subjected to analysis of variance (reported in Table XII), no significant differences are noted either between groups or between anxiety levels. All groups forgot approximately the same amount in the interval between Day 1

TABLE IX

Duncan's New Multiple Range Test Applied to the
Differences Between K = 6 Treatment Means For
The Initial Score (T_{36-38}) on Day 2.

Means	HASL 221.4	HAC 197.9	HASE 192.3	LAC 186.1	LASE 180.4	LASL 156.4	Shortest Sign. R $\alpha .05$ $\alpha .01$
HASL		23.5	29.1	35.3	41.0	65.0 ^b	$R_2 = 43.0$ 56.8
HAC			5.6	11.8	17.5	41.5	$R_3 = 45.3$ 59.3
HASE				6.2	11.9	35.9	$R_4 = 46.9$ 60.9
LAC					5.7	29.7	$R_5 = 47.9$ 62.1
LASE						24.0	$R_6 = 48.7$ 63.1
LASL							

^b significant at the .01 level of confidence.

TABLE X

Duncan's New Multiple Range Test Applied to The
Differences Between K = 6 Treatment Means of
The Final Score (T_{68-70}) on Day 2.

Means	HASL 120.8	HAC 119.9	HASE 117.9	LASE 108.8	LAC 106.8	LASL 90.6	Shortest Sign. R $\alpha .05$
HASL		0.9	2.9	12.0	14.0	30.2 [@]	$R_2 = 25.1$
HAC			2.0	11.1	13.1	29.3 [@]	$R_3 = 26.5$
HASE				9.1	11.1	27.3 [@]	$R_4 = 27.3$
LASE					2.0	18.2	$R_5 = 27.9$
LAC						16.2	$R_6 = 28.4$
LASL							

[@] significant at the .05 level of confidence.

TABLE XI

Forgetting From Day 1 to Day 2.

Group	DAY 1 \bar{X} Final Score	DAY 2 \bar{X} Initial Score	Difference	t [@]
HAC	169.0 \pm 59.6	197.9 \pm 65.2	- 28.9	4.93
HASE	179.3 \pm 62.0	192.3 \pm 70.5	- 26.6	3.77
HASL	179.3 \pm 72.3	221.4 \pm 98.5	- 42.1	3.37
LAC	145.5 \pm 51.0	186.1 \pm 54.9	- 40.6	4.10
LASE	163.1 \pm 46.9	180.4 \pm 40.7	- 17.3	2.49
LASL	135.9 \pm 47.4	156.4 \pm 57.3	- 20.5	3.32

@ With $n = 20$, t is required to exceed 2.1 for significance at the .05 level and 2.9 for significance at the .01 level.

and Day 2 test.

The percentage of the amount learned on Day 1 and the amount forgotten between Day 1 and Day 2 is reported in Table XIII. All six groups achieved over 80 percent of their total learning score on Day 1. The range is from 81.2 percent for HASL to 86.3 percent for LAC. The amount forgotten by the groups was spread over a larger range from 10.6 percent (LASE) to 27.9 percent (LAC).

The Effect of the MAS and Stress Upon Performance in Day 1. Table XIV depicts the results obtained when variance analysis was used on the data for the stress period (averaged trials four to six) on Day 1. In the pre-stress period (averaged trials one to three) no significant differences in performance levels are observed between the six groups.

TABLE XII

Variance Analysis of the Forgetting Which
Occurred Between Day 1 and Day 2.

Source of The Variance	df	MS	F@
Anxiety Level	1	1251.30	0.92
Experimental Conditions	2	1762.69	1.29
Interaction (AL X EC)	2	2909.39	2.13
Error (within cells)	114	1363.35	
Total Sum of Squares	119		

@ For df 2,114 and 1,114, F must exceed 3.07 and 3.92
respectively to be significant at the .05 level of confidence.

TABLE XIII

Percentages of the Amount Learned on Day 1
and the Amount Forgotten
Between Day 1 and Day 2.

Group	Percentage Learned Day 1	Percentage Forgotten From Day 1 to Day 2.
HAC	82.2	17.1
HASE	82.9	16.0
HASL	81.2	23.5
LAC	86.3	27.9
LASE	81.7	10.6
LASL	83.5	15.0

However, during the stress period, there is a significant difference between the two anxiety levels ($F = 6.55$, $p < .05$). In addition, a significant 'groups effect' ($F = 4.26$, $p < .05$) and 'interaction effect' ($F = 19.66$, $p < .01$) are also present during this period. The results obtained when the ordered means of the above analysis are subjected to Duncan's New Multiple Range Test are reported in Table XV. HASE is the only group found to differ from other groups. Its performance level during the stress period is significantly ($p < .01$) different from the LAC and LASL groups. Although differences between the LASE group and the LAC and LASL groups closely approach significance there is no statistically significant difference between LASE and any other group.

In the immediate post-stress period (averaged trials seven to nine) there is no significant difference between the SE groups and any of the other four groups. Nor is any significant difference present between the two anxiety levels. The difference present fails to reach significance (Table XIV). This result is verified by the Duncan's New Multiple Range Test (Table XVI). No significant differences exist between any of the means of the six groups indicating that the performance level of all groups was approximately the same in the post-stress period. The profile of the changes around the stress period is illustrated in Figure VII.

A second method of analyzing the data concerns the amount of change between the initial score and the early stress period score. The resulting score is designated the delta (or

difference) score. The analysis of variance (Table XVIII) of the delta scores for the six groups indicates that only an experimental conditions effect ($F = 5.04$, $p < .05$) is present during the change from the pre-stress to the stress period. The Multiple Range Test for ordered means (Table XVIII) shows significant differences exist between the HASE group and all the other groups with the exception of the LASE group with this difference just failing to reach significance. The LASE group on, the other hand, does not differ significantly from any of the other groups. Therefore, while the improvement of the LASE group was not significantly less than any other group during the stress early period, the HASE group was significantly inferior in their improvement during this period to the four control groups. When the delta score technique is used to study the post stress changes in performance it is evident that there is no significant "anxiety level" or "experimental conditions" effect present immediately after the stress period (i.e. the average of trials four to six minus the average of trials ten to twelve) a significant difference ($F = 3.83$, $p < .05$) is present between the two SE groups and the other four groups. When the results are subjected to Duncan's New Multiple Range Test a significant difference ($p < .05$) is noted between the HASE group and all the other group means in their changes from the stress period to the immediate post-stress period in question (Table XIX). Therefore, the large improvement of the HASE group resulted in their attaining the same performance level of the other groups.

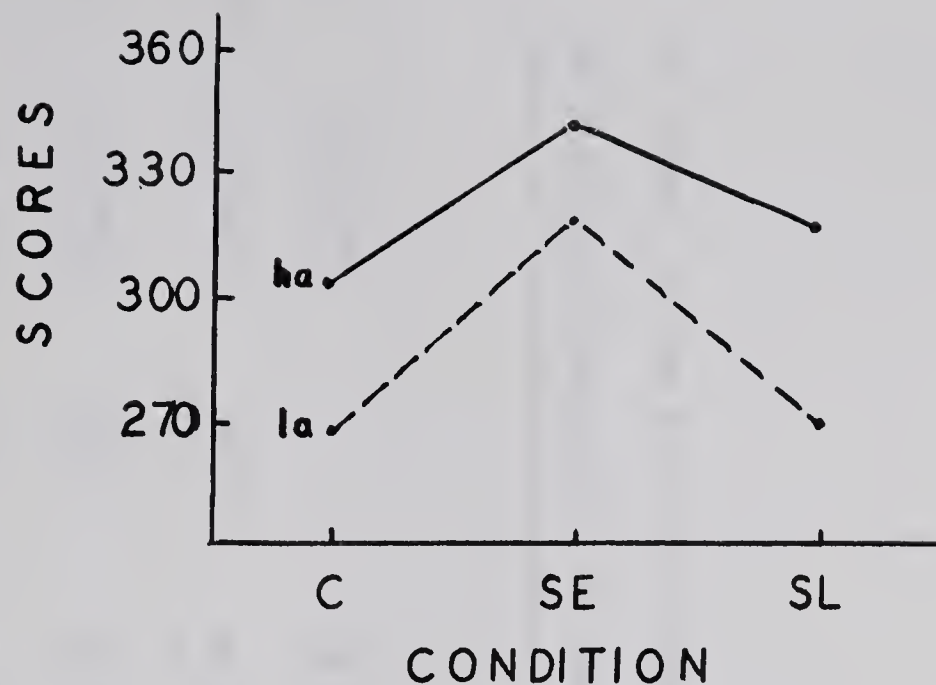


FIGURE VII. Profile Of The Average Scores For The Stress Period (T4-6) On Day 1.

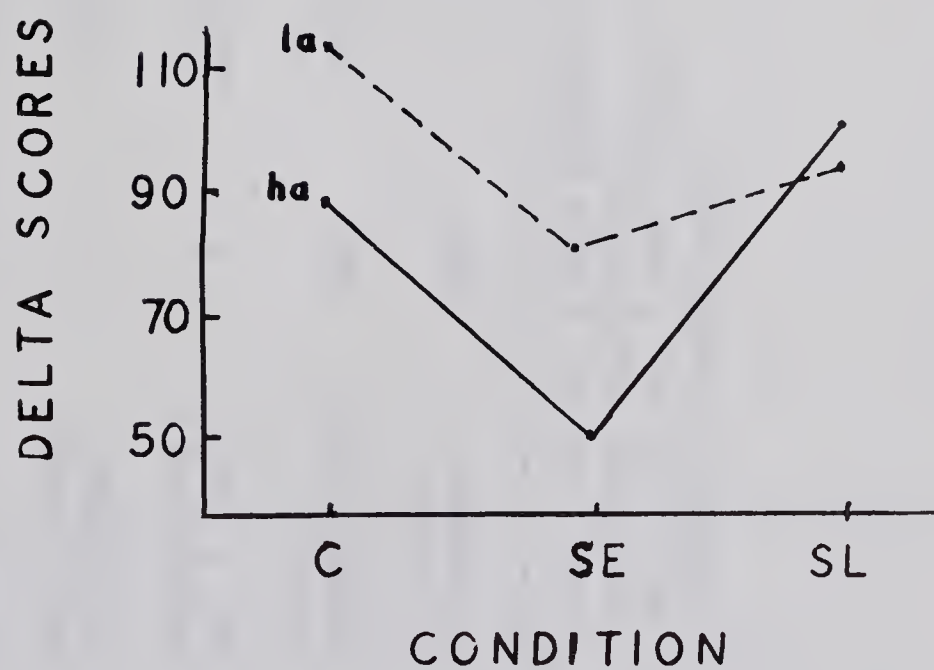


FIGURE VIII. Profile Of The Delta Scores Of The Changes From The Pre-Stress Period To The Stress Period (T1-3 minus T4-6) On Day 2.

TABLE XIV.

Variance Analysis of The Performance Scores (Average of Three Trials) for the
Pre-Stress (T_{1-3}), Stress (T_{4-6}), and Post-Stress (T_{7-9}) Periods
on Day 1

Source of the Variance	df	Pre-Stress Period		Stress Period		Post-Stress Period	
		MS	F ^(a)	MS	F ^(a)	MS	F ^(a)
Anxiety Level	1	9893.50	1.45	35845.62	6.55	21176.29	3.39
Experimental Conditions	2	983.61	0.15	23339.57	4.26	10964.81	1.71
Interaction (AL X EC)	2	11652.70	1.71	107588.90	19.66	5961.01	0.93
Error (within cells)	114	6802.82		5472.85		6418.85	
Total Sum of Squares	119						

^(a) For 1, 114 df, F MUST EXCEED 3.92 and 6.84 for significance at the .05 and .01 levels of confidence respectively.
For 2, 114 df, F MUST EXCEED 3.07 and 4.78 for significance at the .05 and .01 levels of confidence respectively.

TABLE XV

Duncan's New Multiple Range Test Applied to the Differences Between $K = 6$ Treatment Means of the Stress Period (T_{4-6}) on Day 1.

Means	HASE	LASE	HASL	HAC	LASL	LAC	Shortest	Sign. R
	342.3	319.5	317.4	302.5	270.7	268.3	$\alpha .05$	$\alpha .01$
HASE		22.8	24.9	39.8	71.6 ^b	74.0	$R_2 = 46.3$	61.2
LASE			2.1	17.0	48.8	51.2	$R_3 = 48.8$	63.9
HASL				14.9	46.7	49.1	$R_4 = 50.5$	65.7
HAC					31.8	34.2	$R_5 = 51.6$	66.9
LASL						2.4	$R_6 = 52.5$	68.0
LAC								

^b Significant at the .01 level of confidence.

TABLE XVI

Duncan's New Multiple Range Test Applied to the Differences Between $K = 6$ Treatment Means of the Post-Stress Period (T_{7-9}) on Day 1.

Means	LASE	HASE	HASL	HAC	LASL	LAC	Shortest	Sign. R
	280.1	278.5	278.2	266.4	235.8	227.6	$\alpha .05$	
LASE		1.6	1.9	13.7	44.3	52.5	$R_2 = 50.2$	
HASE			0.3	12.1	42.7	50.9	$R_3 = 52.9$	
HASL				11.8	42.4	50.6	$R_4 = 54.7$	
HAC					30.6	38.8	$R_5 = 55.9$	
LASL						8.2	$R_6 = 56.8$	
LAC								

TABLE XVII

Variance Analysis of the Changes in Performance As Expressed By A Delta Score at the Stress and Post-Stress Periods. (i.e. T_{1-3} minus T_{4-6} ; T_{4-6} minus T_{7-9} and T_{4-6} minus T_{10-12})

Source of the Variance	df	Change at Stress Period		Post - Stress Changes	
		$(T_{1-3} \text{ minus } T_{4-6})_{MS}$	$(T_{4-6} \text{ minus } T_{7-9})_{MS}$	$(T_{4-6} \text{ minus } T_{10-12})_{MS}$	$(T_{7-9} \text{ minus } T_{10-12})_{MS}$
Anxiety Level	1	6386.04	2.37	1806.52	1.30
Experimental Conditions	2	13569.45	5.04	2753.49	1.98
Interaction (AL X EC)	2	4692.72	1.74	1939.98	1.40
Error (within cells)	114	2690.14		1388.49	
Total Sum of Squares	119				

(a) For 1, 114 df, F MUST EXCEED 3.92 and 6.84 for significance at the .05 and .01 levels of confidence respectively.
 For 2, 114 df, F MUST EXCEED 3.07 and 4.78 for significance at the .05 and .01 levels of confidence respectively.

TABLE XVIII

Duncan's New Multiple Range Test Applied To The
Differences Between $K = 6$ Treatment Means
For The Change From the Initial Period to The
Stress Period (T_{1-3} minus T_{4-6}).

Means	LAC	HASL	LASL	HAC	LASE	HASE	Shortest	Sign. R
	115.3	104.1	94.1	92.8	85.6	54.4	$<.05$	$<.01$
LAC		11.2	21.2	22.5	29.7	60.9 ^b	$R_2 = 32.5$	42.9
HASL			10.0	11.3	18.5	49.7 ^b	$R_3 = 34.2$	44.8
LASL				1.3	8.5	39.7 [@]	$R_4 = 35.4$	46.1
HAC					7.2	38.4 [@]	$R_5 = 36.2$	46.9
LASE						31.2	$R_6 = 36.8$	47.7
HASE								

[@]Significant at the .05 level of confidence.

^bSignificant at the .01 level of confidence.

As noted previously (Table XVI) there are no significant differences in their mean performance levels at this stage. Examination of the data (Table XX) for the subsequent changes from the stress period to the post-stress period (averaged trials four to six minus averaged trials ten to twelve) by the Multiple Range Test points out a significant ($p < .05$) difference between the LASE group and the HASL group only. The profiles of these changes are represented graphically in Figure VIII.

The Effect of the MAS and Stress Upon Performance in

Day 2. Analysis of variance indicates a significant 'rows effect' (anxiety level) is present throughout Day 2 (Table VII and Table XXI). Examination of the differences between the means of each of the six groups shows that up to the time of the stress period (i.e. in the initial period and in the pre-stress period) the only significant difference evident between the groups is between the HASL group and the LASL group. The differences between the means of the two control groups is clearly non-significant (Tables IX and XXII).

During the stress period (averaged trials sixty-five to sixty-seven) the mean performance score of the HASL group is significantly higher than the mean scores for each of the three LA groups (Table XXIII). There is also a significant difference between the HASL group and the HASE group which under the present condition may be considered a control group since they were not stressed during this period. The difference between the HASL group and its control HAC is not large enough to attain significance at the .05 level of confidence. It is interesting to note that no significant difference is apparent between the LASL group and either the LASE or LAC groups, both of which may be considered control groups. This may be attributed to the fact that the performance level of the LASL group was the lowest prior to the stress late period. With the introduction of the shock and the subsequent decrement in performance, the performance level of the LASL group was the same as the other two LA groups.

TABLE XIX

Duncan's New Multiple Range Test Applied To The Differences Between $K = 6$ Treatment Means For The Changes From the Stress Period to the Immediate Post-Stress Period (T_{4-6} minus T_{7-9}).

Means	HASE 63.8	LASL 39.9	LASE 39.9	HASL 39.1	HAC 36.2	LAC 35.9	Shortest Sign. R α .05
HASE		23.9 [@]	23.9 [@]	24.7 [@]	27.6 [@]	27.9 [@]	$R_2 = 23.4$
LASL			0.0	0.8	3.7	4.0	$R_3 = 24.6$
LASE				0.8	3.7	4.0	$R_4 = 25.4$
HASL					2.9	3.2	$R_5 = 26.0$
HAC						0.3	$R_6 = 26.4$
LAC							

[@] Significant at the .05 level of confidence

TABLE XX

Duncan's New Multiple Range Test Applied to The Differences Between $K = 6$ Treatment Means For The Changes From the Stress Period to a Post-Stress Period (T_{4-6} minus T_{10-12}).

Means	LASE 92.4	HASE 86.3	HAC 71.2	LASL 70.0	LAC 62.4	HASL 58.8	Shortest Sign. R α .05
LASE		6.1	21.2	22.4	30.0	33.6 [@]	$R_2 = 27.9$
HASE			15.1	16.3	23.9	27.5	$R_3 = 29.4$
HAC				1.2	8.8	12.4	$R_4 = 30.4$
LASL					7.6	11.2	$R_5 = 31.1$
LAC						3.6	$R_6 = 31.6$
HASL							

[@] Significant at the .05 level of confidence

TABLE XXI

Variance Analysis of The Performance Scores (Average of Three Trials) for the
Pre-Stress (T_{62-64}), Stress (T_{65-67}) and Post-Stress (T_{68-70}) Periods

on Day 2.

Source of the Variance	df	Pre-Stress Period MS	Stress Period MS	Post-Stress Period MS	F^a
Anxiety Level	1	12038.03	11507.17	9194.50	5.72
Experimental Condition	2	7.49	3036.01	780.30	0.49
Interaction (AL X EC)	2	154.26	1749.95	1244.14	0.77
Error (within cells)	114	1665.87	1912.15	1608.37	
Total Sum of Squares	119				

a For 1, 114 df, F MUST EXCEED 3.92 and 6.84 for significance at the .05 and .01 levels of confidence respectively.
For 2, 114 df, F MUST EXCEED 3.07 and 4.78 for significance at the .05 and .01 levels of confidence respectively.

TABLE XXII

Duncan's New Multiple Range Test Applied to the Differences Between K = 6 Treatment Means of the Pre-Stress Period (T_{62-64}) on Day 2.

Means	HASL 131.8	HAC 125.6	HASE 122.5	LASE 113.6	LAC 107.3	LASL 98.8	Shortest Sign. R $\angle .05$
HASL		6.2	9.3	18.2	24.5	33.0 [@]	$R_2 = 25.6$
HAC			3.1	12.0	18.3	26.8	$R_3 = 26.9$
HASE				8.9	15.2	23.7	$R_4 = 27.9$
LASE					6.3	14.8	$R_5 = 28.5$
LAC						8.5	$R_6 = 28.9$
LASL							

[@] Significant at the .05 level of confidence.

TABLE XXIII

Duncan's New Multiple Range Test Applied to the Differences Between K = 6 Treatment Means of the Stress Period (T_{65-67}) on Day 2.

Means	HASL 146.8	HAC 126.1	HASE 116.9	LASL 112.7	LAC 109.7	LASE 108.7	Shortest Sign. R $\angle .05$
HASL		20.7	29.9 [@]	34.1 [@]	37.1 [@]	38.1 [@]	$R_2 = 27.4$
HAC			9.2	13.4	16.4	17.4	$R_3 = 28.9$
HASE				4.2	7.2	8.2	$R_4 = 29.8$
LASL					3.0	4.0	$R_5 = 30.5$
LAC						1.0	$R_6 = 31.0$
LASE							

[@] Significant at the .05 level of confidence.

The profile of these changes are illustrated in Figure IX.

In the post-stress period, the performance of the LASL group improved to such an extent that it's performance level was significantly superior ($p < .05$) to all HA groups (HAC, HASE, HASL) (Table X).

A more meaningful analysis of the change in performance due to the stressor is provided by the delta score technique. A significant difference ($F = 9.45$, $p < .01$) is noted between the SL groups and the other four groups for the change from the pre-stress period to the stress period (averaged trials sixty-two to sixty-four minus averaged trials sixty-five to sixty-seven) (Table XXIV). Analysis of the means points out a significant difference between the HASL group and the HASE, HAC, LAC and LASE groups. The LASL group differs significantly from the HASE and LASE groups, which may be considered control groups at this point (Table XXV). Therefore, while the stress causes a decrement in the performance of both groups, the effect appears to be most detrimental to the HASL group.

As Table XXIV indicates, the two SL groups are significantly ($F = 17.01$, $p < .01$) different from the other four groups in their change in performance in the post-stress or final trial period (averaged trials sixty-two to four minus averaged trials sixty-five to seven). The mean performance scores for both the HASL and LASL group differ significantly from the HAC, LAC, HASE and LASE groups (Table XXVI). The profiles of these changes around the stress period are illustrated graphically in Figure X.

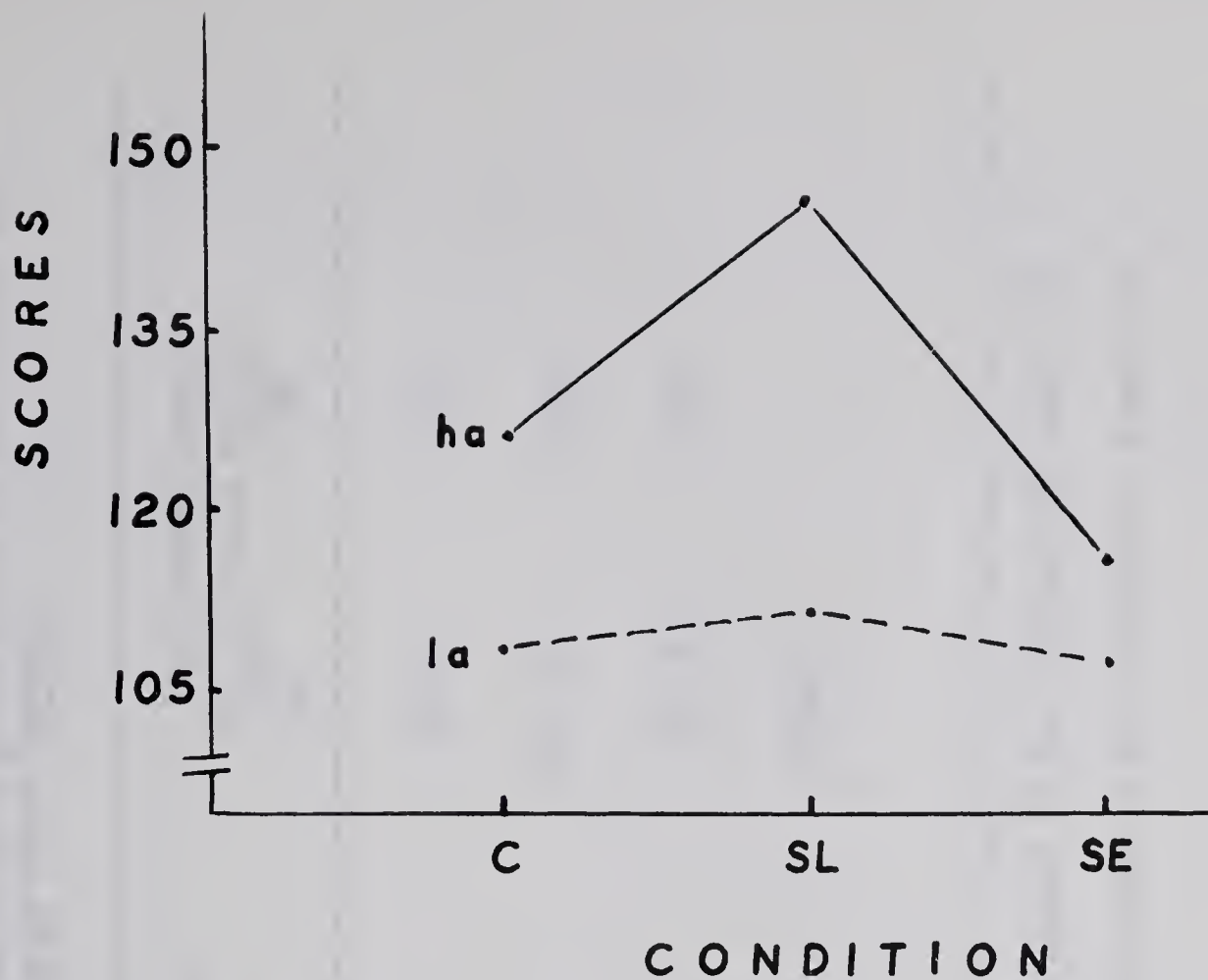


FIGURE IX. Profile Of The Average Scores For The Stress Period ($\overline{T65-67}$) On Day 2.

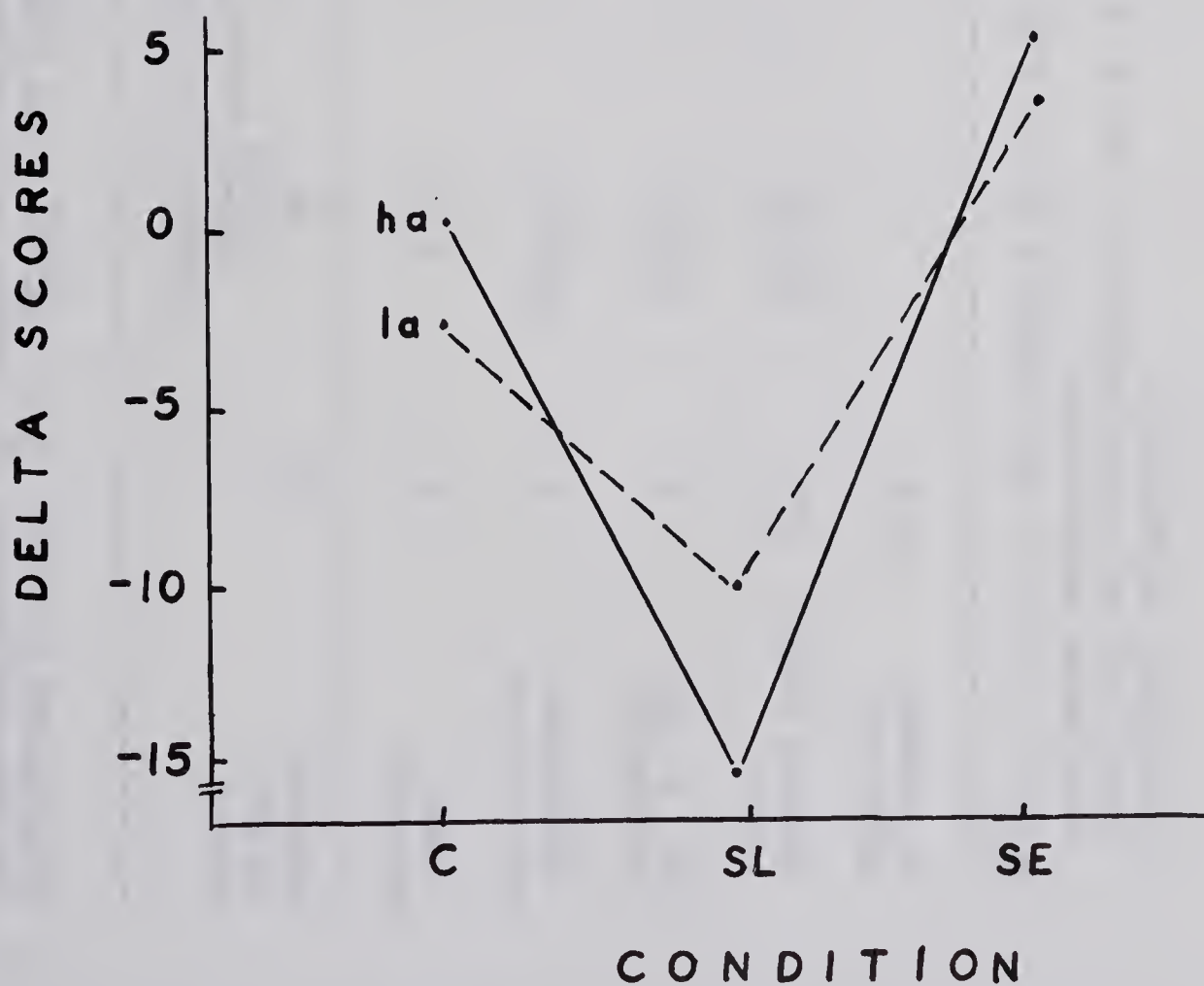


FIGURE X. Profile Of The Delta Scores Of The Changes From The Pre-Stress Period To The Stress Period ($\overline{T62-64}$ minus $\overline{T65-67}$) On Day 2.

TABLE XXIV

Variance Analysis of the Changes in Performance As Expressed By A Delta Score at the Stress and Post-Stress Periods. (i.e. $(\frac{T_{62-64}}{64} \text{ minus } \frac{T_{65-67}}{67} \text{ and } \frac{T_{65-67}}{67} \text{ minus } \frac{T_{68-70}}{70})$).

Source of the Variance	df	Change at the Stress Period ($\frac{T_{62-64}}{64} \text{ minus } \frac{T_{65-67}}{67}$) MS	Post-Stress Change ($\frac{T_{65-67}}{67} \text{ minus } \frac{T_{68-70}}{70}$) MS	F ^a
Anxiety Level	1	1.99	85.34	0.22
Experimental Condition	2	3287.77	6617.86	17.01
Interaction (AL X EC)	2	140.57	67.09	0.17
Error (within cells)	114	347.97	389.07	
Total Sum of Squares	119			

^a For 1, 114 df, F MUST EXCEED 3.92 and 6.84 for significance at the .05 and .01 levels of confidence respectively.
For 2, 114 df, F MUST EXCEED 3.07 and 4.78 for significance at the .05 and .01 levels of confidence respectively.

TABLE XXV

Duncan's New Multiple Range Test Applied to the Differences Between $K = 6$ Treatment Means For the Changes From the Pre-Stress Period to the Stress Period (T_{62-64} minus T_{65-67}) on Day 2.

Means	HASE 5.2	LASE 4.2	HAC 0.6	LAC -2.4	LASL -10.2	HASL -15.0	Shortest $< .05$	Sign. R $< .01$
HASE		1.0	4.6	7.6	15.4 ^b	20.2 ^b	$R_2 = 11.7$	15.4
LASE			3.6	6.6	14.4 [@]	19.2 ^b	$R_3 = 12.3$	16.1
HAC				3.0	10.8	15.6 [@]	$R_4 = 12.7$	16.6
LAC					7.8	12.6 [@]	$R_5 = 13.0$	16.9
LASL						4.8	$R_6 = 13.2$	17.1
HASL								

[@] Significant at the .05 level of confidence

^b Significant at the .01 level of confidence

TABLE XXVI

Duncan's New Multiple Range Test Applied to The Differences Between $K = 6$ Treatment Means For The Changes From the Stress Period to the Post-Stress Period (T_{65-67} minus T_{68-70}) on Day 2.

Means	HASL 26.1	LASL 21.9	HAC 6.2	LAC 4.3	LASE -0.1	HASE -1.1	Shortest $< .05$	Sign. R $< .01$
HASL		4.2	19.9 ^b	21.8 ^b	26.2 ^b	27.2 ^b	$R_2 = 12.4$	16.3
LASL			15.7 [@]	17.6 ^b	22.0 ^b	23.0 ^b	$R_3 = 13.0$	17.0
HAC				11.9	6.3	7.3	$R_4 = 13.5$	17.5
LAC					4.4	5.4	$R_5 = 13.8$	17.8
LASE						1.0	$R_6 = 13.9$	18.1
HASE								

[@] Significant at the .05 level of confidence.

^b Significant at the .01 level of confidence.

DISCUSSION.

Learning. In the present study, contrary to theoretical expectations, no significant differences were present between the HA and LA groups in the amount learned on Day 1, on Day 2, or over the entire seventy trials. These results are contrary to the findings of a considerable body of research which have investigated the Hullian (10) drive theory using the MAS as a gauge of either potential or actual levels of drive (D). Thus, it was predicted that in complex learning tasks, i.e., those involving strong competing responses, learning of HA subjects would be inferior relative to that of LA subjects. This has been confirmed by Farber and Spence (6:120), Ramond (20:120), Montague (17:91) and others (12:234)(14:59)(24:296)(28:61)(31) while Axelrod, et al (1:131), Malmo and Amsel (16:440) and Spence, et al (25:306) were unable to support this prediction.

The difficulty in applying this theoretical model to the present study however, was that, unlike most of the previously mentioned studies, no accurate estimate of habit strength (the number and strength of the competing response tendencies) was possible at any time during the learning of the stabilometer task. Nevertheless, it was speculated that in view of the relatively large number of trials required to reach the asymptote and the considerable individual variability noted there, that the stabilometer was a complex learning task.

The significant differences present between the two anxiety levels in their final levels of performance on both

Day 1 and Day 2 were in the expected direction for complex tasks with the LA subjects being somewhat superior to the HA subjects. If the task had been easy i.e. involved a single dominant response tendency, it would be expected (according to theory) that these performance level differences would be reversed. This has been confirmed by Spence, et al (24:296) (25:306), Taylor (26:55) and Taylor and Chapman (27:671) in four studies investigating learning and performance of anxiety subjects in easy tasks. In these studies, HA subjects were superior relative to LA subjects in learning and performance.

The failure to find significant learning score differences was surprising in that the significant differences present between the two anxiety levels in their final levels of performance on Day 1 and Day 2 were not present on Day 1 in their initial levels of performance. Therefore, when the final level score (represented by the final score), which was significantly different for the two anxiety groups, was subtracted from the quite similar initial level score (represented by the initial score), it could be expected that the resulting learning score would yield a difference. This was not so. Moreover, when the differences between total learning scores (the average of trials one to three minus the average of trials sixty-eight to seventy) were compared for HA and LA subjects, a difference of only seven "movement units" was revealed.

A possible explanation for this failure to find significant differences in the learning scores despite the presence

of significant final score differences may lie in the fact that differences were present in the initial levels of performance but they were not quite large enough to reach significance in the initial score.¹ As learning progressed throughout the first thirty-five trials these differences increased sufficiently to be significant in the final score on Day 1. This difference was then retained throughout Day 2. Therefore, despite significant differences between performance levels, the two anxiety groups were identical in the amount they learned.

Some controversy exists in regard to the role of electric shock as a stressor in learning. As a result of three studies (4:73), (7:456), (8:121) dealing with the effects of electric shock upon finger maze learning and performance. Gilbert (7:456) concluded that

. . . electric shock may, under certain conditions at least, have a facilitating effect upon learning, apart from it's guidance value . . .

These findings were supported by McTeer (15:453) and Travis (30:413). However, Muenzinger (18:439), Muenzinger and Vine (19:67) and Zimny (32) noted no significant facilitative effects, while Beam (3:453) observed that shock stress produced a significant increase in both errors and trials to

¹ For Day 1, initial score, $F = 1.45$ for Anxiety Level with the F ratio required to exceed 3.92 for significance at the .05 level of confidence.

the criterion in a serial learning situation.

In the present study, no 'Experimental Condition' effect was present in the final score or learning score on either Day 1 or Day 2. Thus, the electric shock had no permanent facilitative or decremental effect on either learning or performance. Examination of the differences in group means with the Duncan Multiple Range Test showed a significant difference between the HASL and LASL groups in final score, Day 1, and initial score, Day 2, and a significant difference between the LASL group and the HAC, HASE and HASL groups in final score, Day 2. None of these differences may be attributed to the electric shock stressor except possibly the last, but even this is a performance effect, unrelated to learning.

Performance. According to Ryan (21:103), two important factors which help to determine the effects of stress upon performance are the difficulty of the task itself and the proficiency of the individual in that task when the stress is introduced. Initially it might appear that these two points are almost identical because a highly proficient individual would presumably find the task easy. However, this is not entirely true in the Hullian (10) framework. Here, the difficulty of a task is related to the number and strengths of the competing response tendencies present.

Thus, it was expected that HA subjects would show maximum inferiority relative to the performance of LA subjects when

the stress was introduced "early" in the learning of the stabilometer task. However, as learning progressed and the strength of the correct response tendency increased relative to the incorrect response tendencies, it was theorized that the HA subjects would become less inferior and eventually superior in performance to the LA subjects. Then, when the stressor was introduced "late" in the learning process both groups would show a facilitation effect but the HA subjects, by virtue of their innately higher drive level, would be superior to the LA subjects.

The results of a number of studies investigating the drive theory have not been in close agreement with regard to their findings. Lazarus and Eriksen (13:100) noted that the essential effect of stress was to greatly increase the variance while Bardach (2:420) and Saltz and Riach (23:588) observed that stress late in performance caused a decrement which is contrary to drive theory expectations. Analysis of the latter's results however indicated that subjects at higher levels of performance showed little disruption in performance during shock. Ryan (22:111), (21:103), on the other hand, found that shock stress impaired performance on the stabilometer in the first practice session (22:111) but had no effect on the performance of this task when it was introduced after four practice sessions (21:103).

The results of this study meet drive theory expectations for stress early (Day 1), but fail to satisfy the conditions for the theoretical model on Day 2, for the stress late period.

During the stress early period a significant interaction effect (Anxiety Level X Experimental Conditions) was present. In addition, significant differences were noted between the two anxiety levels as well as between the HASE and LASE groups and the other four groups (which were considered considered control groups at this point). The significant interaction effect is well illustrated when the group means obtained through the delta (difference) technique, (which indicates the amount of change from one period to the next) are subjected to analysis by the Duncan New Multiple Range Test. In the change from the pre-stress period to the stress period, all groups, except the LASE group, improved significantly more than the HASE group. The difference between the HASE and LASE groups just failed to reach significance. Even more important perhaps, is the fact that the LASE group did not differ significantly from any of the four control groups. The stress did not have the same disruptive effect upon the LASE group as it did upon the HASE group.

Also of interest are the delta scores for the changes from the stress period to the immediate post-stress period. Results of the analysis by the Duncan Multiple Range test indicated that during this period the HASE group improved significantly more than any other group including the LASE group and thus, during the post-stress period, it did not differ significantly from any other group.

On Day 2, the results of this study did not fall within theoretical expectations when the electric shock stressor

was introduced late in the learning process. As Figure VI illustrates both groups were adversely affected by the shock stress. While this finding is in agreement with the results of Bardach (2:420) and Saltz and Riach (23:588) it is contrary to the results of Ryan (21:103) and in the opposite direction expected.

Analysis of the results before, during and after the stressor was introduced indicated that both HASL and LASL groups were affected to almost the same degree. The HASL group differed significantly in performance from all other groups with the exception of the LASL group during the stress period. The LASL group, on the other hand, differed significantly from the HASE and LASE groups only. In the post-stress period both the HASL and LASL groups differed significantly in their improvement in performance from all other groups.

Two of the possible explanations for this failure to meet theoretical expectations for stress late, Day 2 present themselves. First; sufficient learning might not have occurred when the stressor was introduced. Admittedly, over eighty per cent of the total learning had occurred by the end of Day 1, and the curves of all of the groups seemed to have leveled off and were approaching the asymptote. However, in the Hullian sense, while the habit strength of the correct response tendency was stronger relative to the strengths of the incorrect response tendencies, the latter might not have been sufficiently reduced with regard to their excitatory

potential (E) to insure that they would not occur. Thus the increase in drive would have been sufficient to bring the incorrect tendencies over the minimum threshold level (L) necessary to make their probability of occurrence possible. If the task had been "overlearned" (as in the Ryan (21:103) study) when the stressor was introduced it might not have had any affect upon performance.

In support of the explanation is the fact that both stress late groups were not affected to exactly the same degree. According to Taylor (29:303):

. . . the possibility exists that under a high-drive level new competing responses with very weak habit strengths may be brought over the threshold value of excitatory potential (E) with the consequence that the probability of occurrence of the correct response is lowered relative to that in a low-drive condition.

During the stress late period, the HASL group differed significantly in change of performance from all other groups except the LASL group while this latter group differed from the HASE and LASE groups only. Thus, the HASL group was more severely affected during the stress period than the LASL group although this difference was small and not significant.

The second possibility which arises relates to the nature of the stressor. The electric shock was "unavoidably" introduced during performance and the subject could do nothing to prevent its' administration. Therefore, it was non-directed i.e., unrelated to performances, and so, probably distractive in nature. Thus, it may be theorized that had the subjects been informed that they could avoid this stressor by improving

their performance over the previous trial, a facilitative effect would have resulted. This was the case in two reaction time studies by Howell (9:22) and Johanson (11). The weakness in this explanation is that while it may be pointed out that both experimental groups reacted almost identically during the stress late period it does not explain the interaction effect (Anxiety Level X Experimental Condition) present during the stress early period. Here, the stressor was also unavoidable and, as far as possible, identical to the stress given late but the effect upon the two anxiety groups was not the same. The LASE group did not appear to be affected while the performance of the HASE group was significantly impaired.

Until further studies are carried out in this area, the writer is inclined to accept the former explanation as the more plausible of the two.

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CHAPTER V

SUMMARY AND CONCLUSIONS

The primary aim of this study was to investigate the effect of externally induced stress on the performance of HA and LA subjects (differentiated on the basis of the Taylor MAS) during the learning of a complex motor task. The secondary purposes were to determine how stress introduced either early or late effected the performance of HA and LA subjects.

After the MAS was administered to the one thousand, two hundred and seventy-two first year University of Alberta male students, one hundred and twenty subjects were selected as subjects. Sixty of these subjects scored twenty-one or over and are referred to as HA, while the other sixty scored seven or below and are referred to as LA. The sixty HA and sixty LA subjects were assigned (in fixed order) to one of three equal groups: Control (C); Stress Early (SE); and Stress Late (SL).

All subjects were given seventy twenty second trials on the stabilometer. All seventy trials were under normal or control conditions except for trials four to six for the SE groups and trials sixty-five to sixty-seven for the SL groups. During these two periods, unavoidable electric shock was administered.

Examination of the learning scores by analysis of variance indicated that neither the MAS, the electric shock stressor nor an interaction of these two, had any effect upon learning. However, when the initial score and the final score for Day 1 and for Day 2 were analyzed as significant difference

between the two anxiety groups was noted for the final score, Day 1 ($F = 4.66$, $p < .05$), the initial score, Day 2, ($F = 5.58$, $p < .05$) and the final score, Day 2 ($F = 5.72$, $p < .05$). Application of the Duncan New Multiple Range test to the ordered means of the above analysis indicated that for final score Day 1 and initial score, Day 2, the only means which differed significantly were those of the HASL and the LASL groups. On Day 2, final score the LASL group differed significantly from all three HA groups: HAC, HASE and HASL.

Performance under 'stress early' and 'stress late' was also examined and the results discussed in terms of the drive theory. During the stress early period a significant interaction effect ($F = 19.66$, $p < .01$) of Anxiety Level X Experimental Conditions was observed. In addition a significant Anxiety Level effect ($F = 6.55$, $p < .05$) and Experimental Conditions effect ($F = 4.26$, $p < .05$) were present during this period. Analysis of the ordered means with the Duncan Test traced significant differences between the means of the HASE group and the LASL and LAC groups ($p < .01$). The LASE group did not differ significantly from any other group.

Analysis of variance of the delta scores for the changes from the pre-stress to the stress period indicated only an Experimental Conditions effect ($p < .05$). However, examination of the mean delta scores by the Duncan Test further illustrated the interaction effect previously mentioned. In the change from the pre-stress period to the stress period all groups with the exception of the LASE group improved significantly

($p < .05$) more than the HASE group. The difference between the LASE and HASE groups just failed to reach significance. In the change from the stress period to the post-stress period, following the removal of the disruptive effects of the shock stressor, the HASE group improved to a significantly ($p < .05$) greater degree than did any of the other groups.

On Day 2, the shock stressor proved to be disruptive to the performance of both the HASL and the LASL groups. This effect was not in the expected direction predicted by current drive theory. Examination of the averaged three trials for the pre-stress, stress and post-stress periods indicated only an Anxiety Level effect ($p < .05$). Analysis of the ordered means by the Duncan test revealed a significant difference between the means of: the HASL group and the LASL group in the pre-stress period ($p < .05$); the HASL group and the LASE, LAC, LASL and HASE groups during the stress period ($p < .05$) and the LASL group and all three HA groups, HAC, HASE and HASL during the post-stress period ($p < .05$).

The delta technique showed only a significant Experimental Condition effect in the amount of change from the pre-stress to the stress period ($F = 9.45$, $p < .01$) and from the stress to the post-stress period ($F = 17.01$, $p < .01$). While the reaction of both groups to the shock stressor was almost identical, the HASL group showed the greater (non-significant) disruptive effect. Examination of the mean changes from the pre-stress to the stress period by the Duncan Range test indicated that the HASL group differed significantly from the

HASE, LASE ($p < .01$), LAC and HAC ($p < .05$) groups. The LASL group differed significantly ($p < .05$) from the HASE and LASE groups only. In the post-stress changes both the HASL and LASL groups improved significantly ($p < .05$) more than the other four groups (HAC, HASE, LAC and LASE).

The following conclusions appear to be justified within the limitations of the population investigated, the learning task employed, and the statistical techniques utilized:

1. Subjects differentiated on the basis of the Taylor Manifest Anxiety Scale Scores did not differ significantly in amount learned on the stabilometer task on Day 1, on Day 2 or over the entire seventy trials.
2. Subjects differentiated on the basis of Taylor Manifest Anxiety Scale scores differed significantly in their final levels of performance on Day 1 and on Day 2.
3. Introduction of a shock stressor had no effect on the amount learned on the stabilometer task.
4. During the stress early period, the shock stressor produced differential effects on the performance of the two experimental anxiety groups.
5. All groups, with the exception of the "low-anxious, stress early" group improved in performance to a significantly greater degree than the "high-anxious early" group during the stress early period. The difference between the "high-anxious stress early" and the "low-anxious stress early" groups just failed to reach significance.
6. The "low-anxious stress early" group did not differ significantly in performance level from any other group during the stress early period. The "high anxious stress early" group differed significantly in performance level from both the "low anxious control" and "stress late" groups.
7. During the stress late period, the shock stressor resulted in a significant decrement in performance for both the experimental anxiety groups.

8. After the shock stressor was removed following the stress late period both experimental anxiety groups showed a significant improvement in performance.

Recommendations. A number of important issues have arisen as a result of this study and could bear further research. Using subjects differentiated on the basis of the Taylor Manifest Anxiety Scale some of the problems which should be investigated are:

1. the effect of stress early versus stress late with a number of other motor tasks, i.e. pursuit rotor.
2. the effect of shock stress on stabilometer performance when the task is overlearned.
3. the differences between directed and non-directed (unavoidable) electric shock on stabilometer performance.

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APPENDIX

APPENDIX A

STATISTICAL TREATMENT

STATISTICAL TREATMENT

Analysis of Variance (Two-Way Classification). An analysis of variance (two-way classification) designed to study the effects of the shock stressor on the measures of learning and performance for the two anxiety levels was used in this study.

<u>e.g. Total Learning Score</u>	<u>Control</u>	<u>Stress Early</u>	<u>Stress Late</u>	ΣX
High-Anxious	$\Sigma X = 5509.1$	5574.0	5964.9	17048.0
Low-Anxious	$\Sigma X = 5635.7$	5935.1	5485.0	17055.8
	ΣX 11144.8	11509.1	11449.9	
		$\Sigma \Sigma X =$	34103.8	
		$\Sigma \Sigma X^2 =$	10191413.98	
		$\Sigma (\Sigma X)^2 =$	194071442.32	

A. Sum of Squares

1. Total Sum of Squares

$$\sum_{r=1}^R \sum_{c=1}^C \sum_{i=1}^n - \frac{T^2}{N} = 10191413.98 - \frac{(34103.8)^2}{120} = 499170.85$$

2. SS Rows (Anxiety Level)

$$\frac{1}{n} \sum_{r=1}^R Tr.^2 - \frac{T^2}{N} = \frac{1163069174.44}{60} - \frac{(34103.8)^2}{120} = 0.51$$

3. SS Columns (Experimental Condition)

$$\frac{1}{n} \sum_{c=1}^R T.c^2 - \frac{T^2}{N} = \frac{387766159.86}{40} - \frac{(34103.8)^2}{120} = 1910.88$$

4. SS Within Cells (Error)

$$\sum_{r=1}^R \sum_{c=1}^C \sum_{i=1}^n x_{rci}^2 - \frac{1}{n} \sum_{r=1}^R \sum_{c=1}^C T_{rc}^2 = 10191413.98 -$$

$$\frac{194071442.32}{20} = 487841.87$$

5. SS Interaction (Experimental Condition X Anxiety Level)

$$\frac{1}{n} \sum_{r=1}^R \sum_{c=1}^C T_{rc}^2 - \frac{1}{n C} \sum_{r=1}^R T_r^2 - \frac{1}{n R} \sum_{c=1}^C T_{\cdot c}^2 + \frac{T^2}{N} =$$

$$= 499170.85 - .51 - 1910.88 -$$

$$487841.87 = 9417.59$$

B. Analysis of Variance

SOURCE	Sum of Squares	Degrees of Freedom	Mean Square	F
Anxiety Level	.51	R-1 = 1	.51	0.00
Experimental Conditions	1910.88	C-1 = 2	955.44	0.22
Interaction (AL X EC)	9417.59	(R-1)(C-1)=2	4708.79	1.10
Error (Within Cells)	487841.87	RC(n-1)	4279.31	
TOTAL	499170.85	nRC-1		

Rows		Columns and Interaction	
Degrees of Freedom	= 1/114	Degrees of Freedom	= 2/114
F at .05	= 3.92	F at .05	= 3.07
F at .01	= 6.84	F at .01	= 4.78

Duncan's New Multiple - Range Test. The new Duncan Multiple Range Test was developed in 1955 and is designed to permit comparison of each treatment mean with every other treatment mean.

e.g. Total Learning Score

$$S_{\bar{x}} = \sqrt{\frac{(\text{error Mean square})}{r}} = \frac{65.42}{20} = 14.63$$

	(1)	(2)	(3)	(4)	(5)	(6)
	HASL	LASE	LAC	HASE	HAC	LASL
	298.3	296.8	281.8	278.7	275.5	274.3
HASL	298.3	1.5	16.5	19.6	22.8	24.0
LASE	296.8		15.0	18.1	21.3	22.5
LAC	281.8			3.1	6.3	7.5
HASE	278.7				3.2	4.4
HAC	275.5					1.2
LASL	274.3					

Shortest Significant R

$$R_2 = 40.96$$

$$R_5 = 45.29$$

$$R_3 = 42.43$$

$$R_6 = 46.76$$

$$R_4 = 43.83$$

Significance of the Difference Between Two Means For Correlated Samples.

$$S_D^2 = \frac{D^2}{N-1} - \bar{D}^2$$

$$S_{\bar{D}}^2 = \frac{S_D^2}{N}$$

$$t = \frac{\bar{D}}{S_D} = \frac{\bar{D}}{\sqrt{\frac{S_D^2}{N}}}$$

degrees of freedom = N - 1

Standard Deviation

$$S = \sqrt{\frac{X^2}{N} - \bar{X}^2}$$

Scoring Key

A SCALE

TRUE: 1, 8, 9, 11, 13, 15, 19, 21, 25, 28,
29, 31, 35, 37, 39, 41, 43, 45, 46,
47, 49, 51, 55, 56, 57, 61, 63, 65,
67, 71, 73, 75, 77, 79, 81, 83, 85,
87, 89.

FALSE: 3, 5, 7, 17, 23, 27, 33, 53, 59, 69,
91.

L SCALE

FALSE: Each Multiple of 6 (6, 12, 18, etc.)

K SCALE

All Remaining items: not scored

TAYLOR MANIFEST ANXIETY SCALE

1. I am often sick to my stomach.
2. I think a great many people exaggerate their misfortunes in order to gain the sympathy and help of others.
3. I do not tire quickly.
4. I have had very few quarrels with members of my family.
5. I am about as nervous as other people.
6. I would rather win than lose in a game.
7. I have very few headaches.
8. I worry over money and business.
9. I work under a great deal of strain.
10. I think nearly anyone would tell a lie to keep out of trouble.
11. I cannot keep my mind on one thing.
12. I do not like everyone I know.
13. I have diarrhea ("the runs") once a month or more.
14. I am against giving money to beggars.
15. I frequently notice my head shakes when I try to do something.
16. I find it hard to make talk when I meet new people.
17. I blush as often as others.
18. Once in a while I put off until tomorrow what I ought to do today.
19. I have nightmares every few nights.
20. People often disappoint me.
21. I worry quite a bit over possible troubles.
22. It makes me impatient to have people ask my advice or otherwise interrupt me when I am working on something important.
23. I practically never blush.
24. I like to know some important people because it makes me feel important.
25. I am often afraid that I am going to blush.
26. It takes a lot of argument to convince most people of the truth.
27. My hands and feet are usually warm enough.
28. I often find myself worrying about something.
29. I sweat very easily even on cool days.
30. My table manners are not quite as good at home as when I am out in company.
31. When embarrassed I often break out in a sweat which is very annoying.
32. I find it hard to set aside a task that I have undertaken, even for a short time.
33. I do not often notice my heart pounding and I am seldom short of breath.
34. It makes me uncomfortable to put on a stunt at a party even when others are doing the same sort of thing.

35. I feel hungry almost all of the time.
36. If I could get into a movie without paying and be sure I was not seen I would probably do it.
37. Often my bowels don't move for several days at a time.
38. At times I feel like swearing.
39. I have a great deal of stomach trouble.
40. At times I am full of energy.
41. At times I lose sleep over worry.
42. I do not read every editorial in the newspaper every day.
43. My sleep is restless and disturbed.
44. Criticism or scolding hurts me terribly.
45. I often dream about things I don't like to tell other people.
46. I have often felt that I faced so many difficulties I could not overcome them.
47. I am easily embarrassed.
48. Sometimes when I am not feeling well I am cross.
49. My feelings are hurt easier than most people.
50. I often think "I wish I were a child again".
51. I wish I could be as happy as others.
52. Often I can't understand why I have been so cross and grouchy.
53. I am usually calm and not easily upset.
54. At times I feel like swearing.
55. I cry easily.
56. I certainly feel useless at times.
57. I feel anxious about something or someone almost all of the time.
58. At times I feel like smashing things.
59. I am happy most of the time.
60. Once in a while I laugh at a dirty joke.
61. It makes me nervous to have to wait.
62. At periods my mind seems to work more slowly than others.
63. At times I am so restless that I cannot sit in a chair for very long.
64. Most people will use somewhat unfair means to gain profit or an advantage rather than to lose.
65. Sometimes I become so excited that I find it hard to get to sleep.
66. I do not always tell the truth.
67. At times I have been worried beyond reason about something that really did not matter.
68. I have often met people who were supposed to be experts who were no better than I.
69. I do not have as many fears as my friends.
70. What others think of me does not bother me.
71. I have been afraid of things or people that I knew could not hurt me.

72. I get angry sometimes.
73. I find it hard to keep my mind on a task or job.
74. I have never felt better in my life than I do now.
75. I am more self-conscious than most people.
76. I like to let people know where I stand on things.
77. I am the kind of person who takes things hard.
78. I gossip a little at time.
79. I am a very nervous person.
80. When in a group of people I have trouble thinking of the right thing to talk about.
81. Life is often a strain for me.
82. I get mad easily and get over it soon.
83. At time I think I am no good at all.
84. Once in a while I think of things too bad to talk about.
85. I am not at all confident of myself.
86. I have periods in which I feel unusually cheerful without any special reason.
87. At time I feel that I am going to crack up.
88. At times my thoughts have raced ahead faster than I could speak them.
89. I don't like to face a difficulty or make an important decision.
90. Sometimes at elections I vote for men about whom I know very little.
91. I am very confident of myself.

APPENDIX C
RAW DATA SHEET

NAME _____

- | | |
|-----|-----|
| 1. | 36. |
| 2. | 37. |
| 3. | 38. |
| 4. | 39. |
| 5. | 40. |
| 6. | 41. |
| 7. | 42. |
| 8. | 43. |
| 9. | 44. |
| 10. | 45. |
| 11. | 46. |
| 12. | 47. |
| 13. | 48. |
| 14. | 49. |
| 15. | 50. |
| 16. | 51. |
| 17. | 52. |
| 18. | 53. |
| 19. | 54. |
| 20. | 55. |
| 21. | 56. |
| 22. | 57. |
| 23. | 58. |
| 24. | 59. |
| 25. | 60. |
| 26. | 61. |
| 27. | 62. |
| 28. | 63. |
| 29. | 64. |
| 30. | 65. |
| 31. | 66. |
| 32. | 67. |
| 33. | 68. |
| 34. | 69. |
| 35. | 70. |

CONDITION	_____
MAS	_____
AGE	_____
HEIGHT	_____
WEIGHT	_____
LIE SCALE	_____

APPENDIX D

DATA

AGE, HEIGHT, WEIGHT, MANIFEST ANXIETY SCALE SCORE and
LIE-SCALE SCORE FOR INDIVIDUAL HIGH-ANXIOUS SUBJECTS.

SUBJECT	GROUP	AGE (yrs.)	HEIGHT (ins.)	WEIGHT (lbs.)	MAS	L-SCALE
GP	Control	18	67	140	29	3
DR	"	18	74	155	27	3
DL	"	19	67	169	33	1
JT	"	17	72	150	27	1
RB	"	19	70	152	26	5
MG	"	18	65	115	29	4
JB	"	18	71	191	38	2
MH	"	18	73	173	27	3
MA	"	20	68	195	23	5
RK	"	18	69	140	22	4
AA	"	18	67	145	23	2
JM	"	20	73	165	29	3
RF	"	17	73	140	23	1
DV	"	27	71	156	23	3
JM	"	19	70	135	24	3
NK	"	17	68	165	24	2
TT	"	20	69	160	32	6
ER	"	19	67	147	22	4
AW	"	19	68	155	23	3
MB	"	20	66	126	26	2
DT	Stress Early	18	70	148	25	2
LO	"	18	69	158	32	6
DG	"	18	68	172	26	5
RP	"	18	58	149	26	5
EH	"	21	70	180	29	6
BW	"	19	62	133	35	2
RL	"	18	71	138	27	1
CJ	"	18	66	170	31	1
BG	"	19	72	195	22	3
OL	"	19	68	160	24	5
CG	"	19	73	188	23	4
BD	"	18	74	155	33	0
BG	"	20	72	155	25	1
JS	"	22	68	160	22	5
PS	"	19	65	140	24	2
JC	"	19	71	155	28	1
RG	"	18	70	150	22	4
RT	"	20	69	165	21	3
WM	"	17	70	135	22	2
AS	"	18	75	155	23	6

SUBJECT	GROUP	AGE (yrs.)	HEIGHT (ins.)	WEIGHT (lbs.)	MAS	L-SCALE
GF	Stress Late	17	69	128	25	3
JH	"	20	69	145	27	6
JP	"	19	66	122	32	1
FA	"	17	70	144	31	1
TV	"	18	73	183	27	2
DC	"	17	66	113	26	4
MT	"	18	67	170	26	0
JP	"	18	74	146	27	5
UZ	"	21	72	160	21	1
PS	"	19	69	160	30	3
DD	"	19	70	185	26	2
EW	"	19	71	170	22	2
EK	"	18	72	180	26	2
DF	"	19	70	198	22	3
GS	"	18	70	160	29	5
HK	"	19	72	155	22	4
BO	"	18	71	175	22	6
DH	"	19	66	125	24	3
GR	"	17	66	125	27	1
ER	"	26	71	182	23	3

AGE, HEIGHT, WEIGHT, MANIFEST ANXIETY SCALE SCORE and
LIE-SCALE SCORE FOR INDIVIDUAL LOW-ANXIOUS SUBJECTS.

SUBJECT	GROUP	AGE (yrs.)	HEIGHT (ins.)	WEIGHT (lbs.)	MAS	L-SCALE
RW	Control	18	69	135	6	3
RA	"	19	74	172	5	3
PG	"	18	68	152	1	4
FG	"	22	72	169	6	3
BG	"	17	72	155	6	5
ON	"	20	68	140	7	4
DY	"	18	72	175	7	4
BL	"	19	73	155	3	4
DT	"	22	70	170	4	6
LS	"	18	66	134	5	6
CT	"	19	71	145	4	4
RT	"	19	70	168	7	5
BM	"	19	68	165	6	5
JH	"	19	72	150	7	5
JC	"	18	68	135	4	1
JH	"	18	69	140	3	5
LC	"	18	72	164	2	6
DS	"	18	70	170	4	5
RH	"	19	66	165	7	4
SK	"	18	72	180	6	5
TB	Stress Early	18	69	171	6	1
JB	"	19	58	137	5	3
BM	"	18	73	168	5	5
IM	"	18	72	150	2	4
RR	"	18	67	158	4	3
BA	"	19	68	145	6	2
PJ	"	19	73	176	6	3
CH	"	18	68	128	5	3
ES	"	21	69	151	7	4
JR	"	18	67	166	2	4
HC	"	20	67	152	7	5
LH	"	18	68	105	4	5
BE	"	20	71	175	6	2
BN	"	20	72	170	6	5
VW	"	19	70	195	7	5
DW	"	17	69	165	5	3
RB	"	19	71	180	2	3
AB	"	21	69	155	3	3
DB	"	23	74	170	2	6
TH	"	18	69	165	7	4

SUBJECT	GROUP	AGE (yrs.)	HEIGHT (ins.)	WEIGHT (lbs.)	MAS	L-SCALE
GW	Stress Late	18	67	145	7	1
HF	"	18	70	152	2	2
RB	"	19	71	146	3	3
BP	"	18	66	131	6	0
CA	"	20	69	149	6	3
BM	"	19	66	160	4	2
JK	"	20	69	149	6	3
WH	"	18	71	159	3	5
DM	"	18	72	170	6	5
AR	"	18	71	155	7	5
RH	"	18	71	155	6	3
RS	"	19	66	135	4	5
JS	"	18	74	175	7	4
BC	"	20	72	118	5	5
RG	"	18	70	155	7	4
DA	"	18	72	155	5	4
FJ	"	19	71	142	6	1
ES	"	18	68	160	1	5
NM	"	19	70	145	5	0
RP	"	18	68	140	7	4

INITIAL, FINAL AND LEARNING SCORES ON DAYS 1 and 2 FOR THE HIGH-ANXIOUS CONTROL GROUP

SUBJECT	DAY 1			DAY 2			TOTAL LEARNING SCORE
	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	
GP	260.7	87.7	173.0	110.3	68.7	41.6	192.0
DR	399.0	169.7	229.3	182.3	98.3	84.0	300.7
DL	385.3	178.0	207.3	197.0	144.3	52.7	241.0
JT	527.6	353.0	174.6	411.3	190.0	221.3	337.6
RB	454.7	171.3	283.4	202.3	153.7	48.6	177.3
MG	277.0	117.7	159.3	149.3	99.7	49.6	177.3
JB	407.3	176.3	231.0	198.7	123.7	75.0	283.6
MH	427.3	232.0	195.3	267.0	188.3	78.7	239.0
MA	391.0	95.0	296.0	105.7	70.7	35.0	320.3
RK	322.7	120.7	202.0	141.0	75.7	65.3	247.0
AA	497.3	203.0	294.3	221.7	143.3	78.4	354.0
JM	320.7	193.0	127.7	246.3	130.0	116.3	190.7
RF	367.0	128.3	238.7	197.0	94.7	102.3	272.3
DV	531.7	169.3	362.4	202.3	142.3	60.0	389.4
JM	259.3	97.7	161.6	153.7	84.0	69.7	175.3
NK	467.0	217.3	249.7	264.0	149.7	114.3	317.3
TT	364.7	115.3	249.4	189.7	124.7	65.0	240.0
ER	388.0	196.7	191.3	191.7	128.3	63.4	259.7
AW	469.0	152.3	316.7	141.3	91.7	49.6	377.3
MB	390.3	206.3	184.0	187.0	96.7	90.3	293.6

INITIAL, FINAL AND LEARNING SCORES ON DAYS 1 AND 2 FOR THE LOW-ANXIOUS CONTROL GROUP.

SUBJECT	DAY 1			DAY 2			TOTAL LEARNING SCORE
	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	
RW	314.0	166.0	148.0	223.7	128.0	95.7	186.0
RA	391.7	156.3	235.4	153.3	74.3	79.0	317.4
PG	416.7	99.0	317.7	128.3	98.7	29.6	318.0
FG	270.7	91.7	179.0	157.0	95.3	61.7	175.4
BG	299.3	69.7	229.6	178.7	105.0	73.7	194.3
ON	298.3	91.3	207.0	164.7	72.3	92.4	226.0
DY	464.7	106.7	358.0	249.7	78.0	171.7	386.7
BL	340.3	189.3	151.0	170.0	157.7	12.3	182.6
DT	332.0	143.7	188.3	154.0	101.3	52.7	230.7
LS	425.7	143.0	282.7	176.0	123.7	52.3	302.0
CT	405.0	103.0	302.0	116.7	62.7	54.0	342.3
RT	407.3	147.3	260.0	194.7	88.7	106.0	318.6
BMc	409.7	157.7	252.0	130.7	74.7	56.0	335.0
JH	454.0	215.3	238.7	253.7	127.0	126.7	327.0
JC	336.3	90.3	246.0	152.7	99.3	53.4	237.0
JH	395.0	181.0	214.0	265.0	149.7	115.3	245.3
LC	482.0	196.7	285.3	237.7	120.0	117.7	362.0
DS	388.7	173.0	215.7	151.7	141.0	10.7	247.7
RH	437.7	108.3	329.4	132.3	60.3	72.0	377.4
SK	502.7	281.3	221.4	331.0	178.7	152.3	324.0

INITIAL, FINAL AND LEARNING SCORES ON DAYS 1 and 2 FOR THE HIGH-ANXIOUS STRESS EARLY GROUP

SUBJECT	DAY 1			DAY 2			TOTAL LEARNING SCORE
	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	
DT	313.7	129.3	184.4	160.0	84.7	75.3	229.0
LO	323.3	141.7	181.6	170.3	101.3	69.0	222.0
DG	417.0	161.0	256.0	222.3	76.7	145.6	340.3
RP	442.7	137.7	305.0	181.7	89.7	92.0	353.0
EH	302.3	138.0	164.3	169.7	116.7	53.0	185.6
BW	353.3	163.0	190.3	181.7	114.7	67.0	238.6
RL	433.3	142.6	290.6	127.3	127.0	0.3	306.3
CJ	507.7	201.0	306.7	299.0	185.3	113.7	322.4
BG	556.0	399.3	156.7	391.3	299.0	92.3	257.0
OL	311.0	156.7	154.3	158.7	80.7	78.0	230.3
CG	344.7	140.3	204.4	137.3	88.0	49.3	256.7
BD	476.7	179.3	297.4	231.0	121.0	110.0	355.7
BG	360.7	127.0	233.7	147.3	83.7	63.6	277.0
JS	492.7	212.3	280.4	271.7	140.7	131.0	352.0
PS	285.7	132.7	153.0	126.0	71.3	54.7	214.4
JC	420.0	210.0	210.0	234.7	160.3	74.4	259.7
RG	428.0	86.3	341.7	90.0	60.3	29.7	367.7
RT	374.7	112.7	262.0	129.0	91.3	37.7	283.4
WMC	328.7	158.3	170.4	154.3	100.7	53.6	228.0
AS	361.3	185.7	275.6	263.0	166.7	96.3	294.6

INITIAL, FINAL AND LEARNING SCORES ON DAYS 1 AND 2 FOR THE LOW-ANXIOUS STRESS EARLY GROUP

SUBJECT	DAY 1			DAY 2			TOTAL LEARNING SCORE
	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	
TB	344.7	125.3	219.4	159.3	88.0	71.3	256.7
JB	274.7	127.7	147.0	157.7	70.0	87.7	204.7
BM	471.7	120.0	351.7	99.0	51.3	47.7	420.4
IMac	530.7	151.3	379.4	188.3	101.0	87.3	429.7
RR	417.3	241.3	176.0	274.7	175.3	99.4	242.0
BA	521.7	156.0	365.7	197.7	116.0	81.7	405.7
PJ	417.3	177.0	240.3	208.3	139.3	69.0	278.0
CH	261.6	80.7	180.9	126.7	70.0	56.7	191.7
ES	454.7	253.3	201.4	232.3	173.0	59.3	281.7
JR	401.7	180.0	221.7	161.3	91.0	70.3	310.7
HC	324.7	107.0	217.7	158.7	76.3	82.4	248.4
LH	493.7	192.0	301.7	240.3	121.3	119.0	372.4
BB	378.3	123.7	254.6	158.7	95.7	63.0	282.6
BN	325.3	147.7	177.6	182.3	95.0	87.3	230.3
VW	529.3	223.0	306.3	213.3	163.3	50.0	366.0
DW	445.3	221.7	223.6	190.0	137.0	53.0	308.3
RB	437.3	153.0	284.3	202.0	77.7	124.3	359.6
AB	433.3	186.0	247.3	150.3	94.7	55.6	338.6
DB	391.0	192.0	199.0	175.0	151.7	23.3	239.3
TH	256.0	103.3	152.7	131.0	87.7	43.3	168.3

INITIAL, FINAL AND LEARNING SCORES ON DAYS 1 and 2 FOR THE HIGH-ANXIOUS STRESS LATE GROUP

SUBJECT	DAY 1			DAY 2			TOTAL LEARNING SCORE
	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	
GF	254.0	91.7	162.3	85.3	60.0	25.3	194.0
JH	221.3	106.7	114.6	159.3	61.7	97.6	159.6
JP	359.7	165.7	194.0	166.3	84.0	82.3	275.7
FA	312.0	99.0	213.0	117.7	70.7	47.0	241.3
TV	296.7	128.7	168.0	145.3	105.7	39.6	191.0
DC	303.7	100.0	203.7	128.0	72.3	55.7	231.4
MT	556.3	188.3	368.0	378.3	165.7	212.6	343.7
JP	376.3	145.3	231.0	210.3	122.3	88.0	254.0
UZ	423.0	267.0	156.0	274.3	139.3	135.0	283.7
PS	400.0	173.7	226.3	154.3	84.0	70.3	316.0
DD	431.3	128.3	303.0	134.0	104.7	29.3	326.6
BW	518.0	320.7	197.3	466.3	227.3	239.0	290.7
EK	529.3	127.3	402.0	145.7	124.7	21.0	404.6
DF	505.3	166.7	338.6	203.7	132.3	71.4	373.0
GS	597.0	349.0	248.0	328.7	181.7	147.0	415.3
HK	442.3	243.0	199.3	280.3	113.0	167.3	329.3
BO	482.3	264.3	218.0	312.3	176.0	136.3	306.3
DH	436.0	156.0	280.0	183.7	100.0	83.7	336.0
GR	474.0	158.7	315.3	218.7	132.7	86.0	341.3
ER	509.7	205.7	304.0	334.7	158.3	176.4	351.4

INITIAL, FINAL AND LEARNING SCORES ON DAYS 1 and 2 FOR THE LOW-ANXIOUS STRESS LATE GROUP

SUBJECT	DAY 1			DAY 2			TOTAL LEARNING SCORE
	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	INITIAL SCORE	FINAL SCORE	LEARNING SCORE	
GW	222.7	86.3	136.4	75.0	54.7	20.3	168.0
HF	382.3	155.7	226.6	195.3	87.7	107.6	294.6
RB	323.7	81.0	242.7	130.3	71.7	58.6	252.0
BP	303.3	118.7	184.6	105.0	54.0	51.0	249.3
CA	418.7	152.0	266.7	208.7	114.3	94.4	304.4
BM	395.3	232.3	163.0	220.0	127.0	93.0	268.3
JK	292.3	93.7	198.6	101.7	59.7	42.0	232.6
WH	289.7	82.7	207.0	131.0	81.7	49.3	208.0
DM	330.3	84.0	246.3	91.7	66.7	25.0	263.6
RA	468.7	180.3	288.4	246.0	124.3	121.7	344.4
RH	289.0	72.0	217.0	74.0	66.3	7.7	222.7
RS	500.3	179.0	321.3	178.7	103.7	75.0	396.6
JS	450.0	230.0	220.0	258.0	149.0	109.0	301.0
BC	382.0	177.0	205.0	228.0	137.7	90.3	244.3
RG	501.0	174.3	326.7	176.0	137.7	38.3	363.3
DA	367.0	112.7	254.3	128.7	66.7	62.0	300.3
FJ	323.7	155.0	168.7	217.3	102.7	114.6	221.0
ES	330.3	115.3	215.0	109.3	76.7	32.6	253.6
NMc	372.3	115.0	257.3	133.3	72.3	61.0	300.0
RP	355.0	122.3	232.7	119.7	58.0	61.7	297.0

PERFORMANCE SCORES FOR THE PRE-STRESS, STRESS and POST-STRESS PERIODS
ON DAYS 1 and 2 FOR THE HIGH-ANXIOUS CONTROL.

SUBJECTS	DAY 1			DAY 2		
	PRE-STRESS	STRESS	POST-STRESS	PRE-STRESS	STRESS	POST-STRESS
GP	260.7	212.7	210.0	80.7	63.7	68.7
DR	399.0	310.0	285.7	90.3	112.0	98.3
DL	385.3	357.7	261.3	144.3	139.3	144.3
JT	527.6	541.3	478.0	191.0	189.7	190.0
RB	454.7	335.7	345.3	160.3	157.0	153.7
MG	277.0	215.0	170.7	115.0	112.7	99.7
JB	407.3	402.7	357.7	160.0	164.3	123.7
MH	427.3	301.0	298.0	201.0	194.7	188.3
MA	391.0	250.0	183.3	66.7	72.3	70.7
RK	322.7	180.7	150.3	78.0	77.3	75.7
AA	497.3	414.0	360.0	137.0	165.3	143.3
JM	320.7	279.0	240.0	114.3	128.7	130.0
RF	367.0	209.0	199.0	112.3	84.0	94.7
DV	531.7	431.3	358.0	142.0	134.7	142.3
JM	259.3	139.7	168.7	89.0	96.3	84.0
NK	467.0	337.7	245.3	167.0	167.3	149.7
TT	364.7	279.0	230.3	119.0	121.0	124.7
ER	388.0	288.3	274.3	134.3	132.7	128.3
AW	469.0	313.0	255.3	110.7	104.0	91.7
MB	390.3	253.0	255.7	98.7	106.3	96.7

PERFORMANCE SCORES FOR THE PRE-STRESS, STRESS and POST-STRESS PERIODS
ON DAYS 1 and 2 FOR THE LOW-ANXIOUS CONTROL.

SUBJECT	DAY 1			DAY 2		
	PRE-STRESS	STRESS	POST-STRESS	PRE-STRESS	STRESS	POST-STRESS
RW	314.0	230.7	224.3	121.3	192.3	128.0
RA	391.7	286.0	223.7	86.7	97.7	74.3
PG	416.7	295.3	225.0	88.0	85.0	98.7
FG	270.7	233.3	177.0	97.3	80.7	95.3
BG	299.3	187.7	110.3	97.7	83.0	105.0
ON	298.3	152.7	158.3	82.7	65.0	72.3
DY	464.7	337.0	233.7	102.3	87.3	78.0
BL	340.3	262.0	235.0	134.7	141.3	157.7
DT	332.0	249.3	212.3	97.7	106.3	101.3
LS	425.7	291.7	193.0	105.0	121.0	123.7
CT	405.0	218.0	160.0	81.3	79.7	62.7
RT	407.3	290.7	226.7	99.3	101.7	88.7
BMc	409.7	274.3	207.0	82.7	85.0	74.7
JH	454.0	367.7	261.0	122.7	139.3	127.0
JC	336.3	220.3	201.3	103.7	95.7	99.3
JH	395.0	264.0	280.3	141.3	135.7	149.7
LC	482.0	353.7	306.7	133.0	129.3	120.0
DS	388.7	348.0	303.3	123.7	151.3	141.0
RH	437.7	213.0	179.0	65.3	49.3	60.3
SK	502.7	389.7	433.0	179.7	168.0	178.7

PERFORMANCE SCORES FOR THE PRE-STRESS, STRESS and POST-STRESS PERIODS
ON DAYS 1 and 2 FOR THE HIGH-ANXIOUS STRESS EARLY

SUBJECTS	DAY 1			DAY 2		
	PRE-STRESS	STRESS	POST-STRESS	PRE-STRESS	STRESS	POST-STRESS
DT	313.7	285.7	248.0	118.7	107.0	84.7
LO	323.3	297.3	215.7	95.3	81.3	101.3
DG	417.0	326.0	325.7	87.7	90.0	76.7
RP	442.7	365.3	307.0	103.0	106.3	89.7
EH	302.3	253.3	220.0	110.0	111.3	116.7
BW	353.3	280.3	324.7	97.0	111.3	114.7
RL	433.3	298.3	272.7	144.7	121.3	127.0
CJ	507.7	386.0	348.0	165.3	188.0	185.3
BG	556.0	588.0	406.0	277.0	258.3	299.0
OL	311.0	296.3	246.3	97.7	95.0	80.7
CG	344.7	228.3	176.7	77.3	88.3	88.0
BD	476.7	543.0	380.7	137.7	113.3	121.0
BG	360.7	246.3	204.7	80.3	74.3	83.7
JS	492.7	503.3	474.3	147.0	154.0	140.7
PS	285.7	287.3	212.3	74.0	80.0	71.3
JC	420.0	327.7	308.3	160.3	144.7	160.3
RG	428.0	293.3	165.7	65.0	54.3	60.3
RT	374.7	232.0	152.0	84.3	83.7	91.3
WMC	328.7	283.7	221.7	101.7	109.3	100.7
AS	461.3	524.3	360.0	225.3	166.3	166.7

PERFORMANCE SCORES FOR THE PRE-STRESS, STRESS and POST-STRESS PERIODS
ON DAYS 1 and 2 FOR THE LOW-ANXIOUS STRESS EARLY.

SUBJECTS	DAY 1			DAY 2		
	PRE-STRESS	STRESS	POST-STRESS	PRE-STRESS	STRESS	POST-STRESS
TB	344.7	298.7	247.0	91.7	63.3	88.0
JB	274.7	235.0	188.7	77.7	83.7	70.0
BM	471.7	329.0	290.7	61.3	63.3	51.3
IMac	530.7	295.3	331.0	101.0	116.7	101.0
RR	417.3	379.7	372.0	166.7	156.3	175.3
BA	521.7	418.0	313.3	109.3	130.0	116.0
PJ	417.3	357.3	283.0	143.3	132.3	139.3
CH	261.6	216.7	166.0	63.7	74.3	70.0
ES	454.7	437.7	366.0	157.7	167.0	173.0
JR	401.7	302.0	252.0	115.3	106.7	91.0
HC	324.7	234.0	222.0	81.0	72.7	76.3
LH	493.7	397.7	402.3	144.3	124.0	121.3
BB	378.3	307.0	277.0	107.7	91.3	95.7
BN	325.3	243.3	209.3	113.0	103.7	95.0
VW	529.3	340.3	274.7	166.0	134.0	163.3
DW	445.3	351.3	330.0	130.7	126.7	137.0
RB	437.3	353.3	305.3	135.7	97.7	77.7
AB	433.3	393.0	366.7	107.7	120.7	94.7
DB	391.0	295.7	252.7	112.0	115.3	151.7
TH	256.0	204.7	152.0	86.3	93.3	87.7

PERFORMANCE SCORES FOR THE PRE-STRESS, STRESS AND POST-STRESS PERIODS
ON DAYS 1 and 2 FOR THE HIGH-ANXIOUS STRESS LATE.

SUBJECTS	DAY 1			DAY 2		
	PRE-STRESS	STRESS	POST-STRESS	PRE-STRESS	STRESS	POST-STRESS
GF	254.0	191.7	165.3	67.7	71.0	60.0
JH	221.3	166.0	143.7	76.0	90.7	61.7
JP	359.7	293.3	267.0	127.7	154.7	84.0
FA	312.0	194.7	142.0	70.0	72.0	70.7
TV	296.7	252.3	216.7	99.0	106.3	105.7
DC	303.7	193.3	171.3	78.0	96.0	72.3
MT	556.3	469.0	414.7	180.3	236.7	165.7
JP	376.3	267.7	223.3	115.0	116.0	122.3
UZ	423.0	369.7	352.0	165.0	208.0	139.3
PS	400.0	288.0	240.7	69.7	93.0	84.0
DD	431.3	276.7	236.0	121.0	111.7	104.7
BW	518.0	355.3	356.0	271.3	284.0	227.3
EK	529.3	305.7	285.7	122.0	133.7	124.7
DF	505.3	317.3	273.7	174.7	164.7	132.3
GS	597.0	513.7	528.0	169.7	212.0	181.7
HK	442.3	409.3	323.0	133.7	193.3	113.0
BO	482.3	387.3	340.3	188.0	206.3	176.0
DH	436.0	363.7	271.7	115.0	112.7	100.0
GR	474.0	333.7	271.3	138.3	114.7	132.7
ER	509.7	398.7	342.3	153.7	159.0	158.3

PERFORMANCE SCORES FOR THE PRE-STRESS, STRESS AND POST-STRESS PERIODS
ON DAYS 1 and 2 FOR THE LOW-ANXIOUS STRESS LATE.

SUBJECTS	DAY 1			DAY 2		
	PRE-STRESS	STRESS	POST-STRESS	PRE-STRESS	STRESS	POST-STRESS
GW	22.7	164.0	109.7	48.0	43.0	54.7
HF	382.3	377.3	306.7	126.0	111.7	87.7
RB	323.7	193.7	144.3	76.3	64.0	71.7
BP	303.3	174.7	177.7	67.7	64.3	54.0
CA	418.7	357.7	292.0	105.3	141.3	114.3
BM	395.3	329.3	322.7	140.7	127.7	127.0
JK	292.3	226.0	174.0	71.0	98.7	59.7
WH	289.7	206.7	182.0	77.3	85.0	81.7
DM	330.3	212.0	197.0	72.0	86.7	66.7
RA	468.7	303.7	241.3	120.0	158.0	124.3
RH	289.0	193.3	164.7	50.0	65.0	66.3
RS	500.3	350.0	291.3	118.0	169.3	103.7
JS	450.0	372.3	370.7	169.7	218.0	149.0
BC	382.0	360.7	281.3	167.3	166.3	137.7
RG	501.0	368.7	363.3	149.7	174.7	137.7
DA	367.0	218.7	205.0	71.3	82.3	66.7
FJ	323.7	300.0	284.7	121.7	119.0	102.7
ES	330.3	210.7	180.0	74.0	95.7	76.7
NMc	372.3	282.0	207.3	74.3	83.7	72.3
RP	355.0	213.3	220.0	76.3	99.7	58.0

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